NELSON
CENGAGE Learning

VCE

# Psychology Research Methods

## Workbook

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# 1 Establishing research

## 1.1 Steps in research

Researchers, or experimenters, use a series of orderly and systematic steps to plan, conduct, interpret and report on the research they undertake. Seven steps are used in conducting psychological research. Most of these steps will be covered in further detail later in this workbook.

### Step 1: Identify the research problem

The first step in psychological research is to identify an area in which to conduct a study. When a psychological researcher has an idea of their topic of interest, they must conduct a *literature search*, which involves finding and reading relevant research articles and literature on the topic. Once they have completed the literature search, the researcher must develop a testable research question or problem. For example, a researcher may be interested in investigating the causes of or influences on eating disorders in adolescent females. The researcher would do a literature search on the broad topic, then identify a research question, such as *Is the prevalence of eating disorders in adolescent girls affected by whether they have/had a relative who has suffered from an eating disorder currently or in the past?*

### Step 2: Formulate a hypothesis

The second step in psychological research is to formulate a testable hypothesis. A hypothesis is a testable prediction about the relationship between two or more variables (events or characteristics). In other words, a hypothesis is an educated guess about the results of the experiment; for example, *It is hypothesised that adolescent girls who have or had a relative who has suffered or is suffering from an eating disorder are more likely to have an eating disorder than those with no relatives who suffer/suffered from an eating disorder*.

A hypothesis is based on the information gathered in the literature search; it is not just a guess made without any prior knowledge or investigation. The hypothesis is developed before the research is conducted and is written as a very specific statement.

### Step 3: Design the method

The third step is to design the method that will be used to undertake the research. The research method determines how the researcher will test the hypothesis. When designing the method, the researcher must determine which participants will be studied, how many participants will be in the study, what the participants will do and under what conditions, and what will be measured in the study. After choosing the participants that will take part in the study, the researcher must decide how the data will be collected. Data-collection procedures include controlled experiments, naturalistic observations, correlations, surveys, interviews and case studies.

### Step 4: Collect the data

The fourth step is to collect the data. Here, the researcher should follow the method developed in Step 3. To measure participants' responses, a researcher can use any of a variety of data-collection techniques, including questionnaires, direct observation, psychological tests or examination of files and documents. Remember that 'data' is the plural form of 'datum'.

### Step 5: Analyse the data

The fifth step of any psychological research is to analyse the data. Data analysis involves organising, summarising and representing the raw data in a coherent and logical manner. Raw data are the actual data collected from a study.

A research investigation will often result in large amounts of raw data that are then 'broken down' into smaller sets of numbers (for example, an average score in a set of scores). These numbers are known as *statistics*. *Descriptive statistics* are used to describe, summarise and organise data. Examples of descriptive statistics include graphs; tables; the mean, median and mode; and frequency distributions.

### Step 6: Interpret the results

Once the data have been summarised and organised, they must be interpreted. Interpreting results involves forming conclusions about what the data show. A *conclusion* is a decision or judgement about the meaningfulness of the results of a study. *Inferential statistics* are statistics that allow you to make inferences and conclusions about the data, and are often used to interpret results. Such statistics allow us to explain the significance of the data.

### Step 7: Report the findings

There is no point in conducting psychological research if you cannot share it with other psychologists and researchers. Therefore, the final step in psychological research is to report the data to others. After conducting a study, the researcher usually prepares a report that is either submitted to a journal or periodical and/or presented to other psychologists at a conference. Once a research report is published, other researchers use it in *their* literature searches and further investigations. Publication also enables the general public to benefit from research findings.


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## Check your understanding

**1** Fill in the flow chart to identify the seven steps in psychological research. Next to each step, give an example of what *may* be done or found in each step. The research problem has been identified for you.

| | |
|---|---|
| **Step 1:** ______ | Does listening to music while studying improve your retention of the material you are studying? |
| **Step 2:** ______ | It is hypothesised that … ______ |
| **Step 3:** ______ | Participants will … ______ |
| **Step 4:** ______ | Data will be collected by … ______ |
| **Step 5:** ______ | The raw data show that … ______ |
| **Step 6:** ______ | The findings suggest that … ______ |
| **Step 7:** ______ | |

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# 1.2 Independent and dependent variables

An experiment is a study that investigates a cause-and-effect relationship between two or more variables; that is, whether a change in one thing has an impact on another. A variable is any condition that can change. For example, if research involved testing the effectiveness of a new memory drug on participants' retention of a list of nonsense words, two variables would be involved when conducting this experiment: whether or not participants are given the drug, and the level of participant retention of the nonsense words. The first variable would be manipulated by the experimenter; the second variable is the participants' responses.

## The independent variable

An independent variable (IV) is a condition that an experimenter systematically manipulates, changes or varies in order to gauge its effect on another variable. An IV is a suspected cause of differences in behaviour or results between groups used in an experiment. If we have two groups of participants in an experiment, one group would be exposed to the independent variable and the other would not, and the results of the experiment for each group would be recorded. The researcher can then see the difference between the results of the group exposed to the independent variable and the group that was not, and potentially make inferences about whether the IV can be said to have caused the difference between the results. The results in this case would be known as the *dependent variable*, so inferences would be made about whether the IV can be said to have had an impact on the dependent variable.

## The dependent variable

The dependent variable (DV) is the condition in an experiment that is affected by the IV and is used to measure the IV's effect. Dependent variables reveal the effects that IVs have on behaviour. Such effects are often revealed by measures of performance, such as test scores or number of goals scored. A DV 'depends' on another variable, the IV, to determine whether it changes and by how much.

When stating the variables in an experiment, it is important to operationalise them by explaining what each variable is and how it will be measured.

For example, a researcher examining the effects of a new treatment therapy for paranoid schizophrenia might divide a sample into two groups. He could ensure that participants in one group take the new drug every day for a week and that participants in the other group have no treatment at all. The experimenter is manipulating this condition. He could then measure the number of hallucinations the patients in each group reportedly experience over the week. In this scenario the operationalised IV is the presence (or not) of the drug (i.e. whether or not the patients take the new drug), and the operationalised DV is the number of hallucinations reportedly experienced in a one-week period. This experiment allows the researcher to see whether the drug (IV) affects the number of hallucinations (DV).

As another example, a study into the effects of alcohol on driving may involve one group of participants who drink five alcoholic beverages in an hour and one group of participants who drink five glasses of water in an hour. The participants may then be asked to navigate an obstacle course on a driving simulator, in which they must avoid hitting the witches' hats. In this experiment, the experimenter is manipulating whether the participants drink alcohol or water, and the results will be the number of witches' hats they hit. Therefore, the operationalised IV is the type of drink the participants drank and the operationalised DV is the number of witches' hats that participants hit when operating a driving simulator. This experiment allows the researcher to see whether the presence of alcohol (IV) affects driving ability (DV).

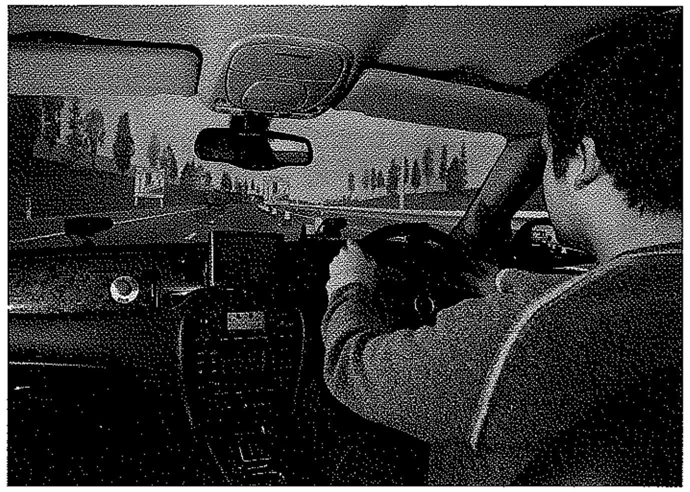

**Figure 1.1** The dependent variable must be operationalised so we know what is being measured; for example, the number of witches' hats hit when using a driving simulator after consumption of alcohol or water.

As you can see from the examples we have given, typically the research question involves assessing the effect of the IV on the DV.


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## Check your understanding

**1** Identify the operationalised independent and dependent variables in each experiment.

**a** Professor Tallent is examining the effect of hunger as motivation in rats trying to run through a maze. She uses two groups of rats, and times how long it takes members of each group to successfully complete the maze to find a piece of cheese. Professor Tallent feeds the rats in one group before they enter the maze, but does not feed the rats in the other group until they have completed the maze.

**i** Operationalised IV: ..........

**ii** Operationalised DV: ..........

**b** Emma has always been told that she makes excellent muffins, but she wants to know which of her two favourite flavours she makes is the best. For two months (January and February), Emma makes muffins and distributes them to her friends and family. She makes the same amount of muffins each month and distributes them to the same people, but for the month of January she makes only blueberry muffins and for the month of February she makes only chocolate muffins. Emma counts the number of compliments she receives on her muffins for the two months.

**i** Operationalised IV: ..........

**ii** Operationalised DV: ..........

**c** Luli was in charge of a large corporation that taught people second languages for travel purposes. She had equal numbers of students in two six-week programs: one where students learned by hearing and repeating the foreign words and another where students learned by reading and writing the foreign words. Luli decided to test which method was most effective by giving the students of each program a test at the end of the six weeks.

**i** Operationalised IV: ..........

**ii** Operationalised DV: ..........

**2** Parents often tell children old wives' tales and stories to discourage them from displaying undesirable behaviours. Design an experiment to test the following well-known statements. Remember to describe your independent and dependent variables.

**a** Sitting too close to the television is detrimental to your vision.

Experiment: ..........

..........

..........

..........

Operationalised IV: ..........

Operationalised DV: ..........

**b** Eating bread crusts makes your hair curly.

Experiment: ..........

..........

..........

..........

Operationalised IV: ..........

Operationalised DV: ..........

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# 1.3 Formulating a hypothesis

As previously mentioned, Step 2 in psychological research involves a researcher making an educated guess about the relationship between variables in an experiment. This statement, or testable prediction, about the results of an experiment is known as a *hypothesis*. As we have just learnt, the results and conclusions of an investigation or experiment are determined by how the IV affects the DV.

A research hypothesis is a general prediction about the direction of interaction between the IV and the DV and the population from which the sample is drawn. That is, in the presence of different levels of the IV, does the DV increase or decrease? For example, you might predict that decreased amounts of sleep lead to memory problems in adolescent males. This is obviously a very general statement; it does not tell us how much sleep or what *types* of memory problems are being referred to, or how memory problems might be being measured.

An operational hypothesis, on the other hand, is a testable prediction that explains exactly how the variables will be measured and manipulated, as well as the population from which the sample is drawn. Thus, an operational hypothesis is a workable, testable and repeatable hypothesis.

It is important that any hypothesis you write includes four elements:

1. a testable prediction about the direction of interaction between variables
2. the population from which the sample is drawn
3. the independent variable (that which is manipulated); operationalised, if it is an operational hypothesis
4. the dependent variable (that which is measured); operationalised, if it is an operational hypothesis.

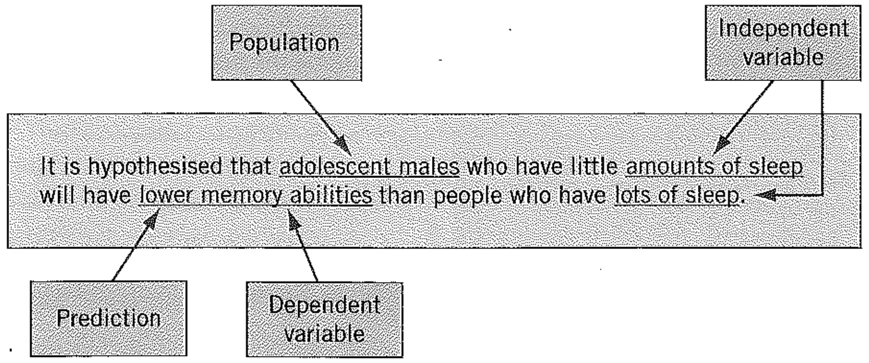


**Figure 1.2** A research hypothesis

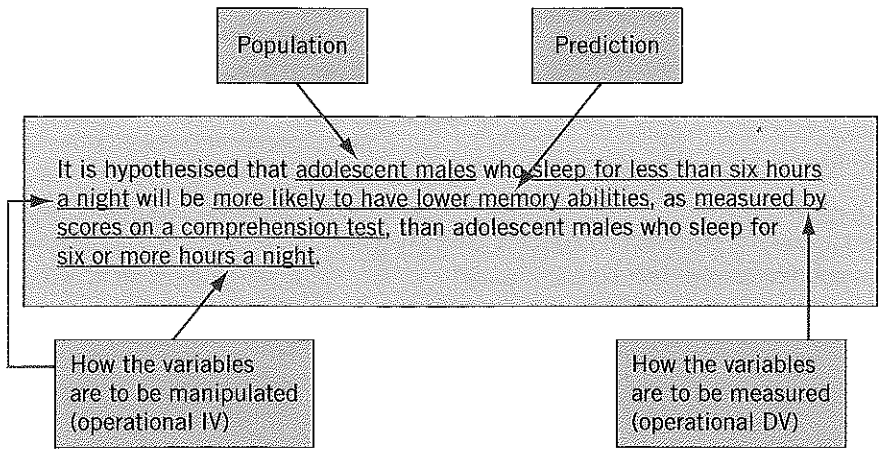


**Figure 1.3** An operational hypothesis



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## Check your understanding

For each of the following scenarios, identify the independent variable and dependent variable. For the first scenario, formulate a research hypothesis and an operational hypothesis. For the other two scenarios, formulate only an operational hypothesis, but remember to operationalise the variables you identify.

**1** Max is conducting research to investigate whether sleep quality is improved by meditating. He investigates a group of 40-year-old males, where half of the group practises meditation for 10 minutes before going to bed every night for one week, and the other half does not. Upon waking each morning for that week, the participants in both groups are to rate their quality of sleep on a scale from 1 to 10. An average of each participant's seven ratings is taken.

Independent variable: ……………………

Dependent variable: ……………………

Research hypothesis: ……………………

……………………

……………………

……………………

Operational hypothesis: ……………………

……………………

……………………

……………………

**2** When a Year 12 Psychology teacher taught her lessons in the first half of the year, she wrote notes on the board for her class to copy. She was disappointed in the results obtained by her class in the mid-year exam, and wanted to investigate whether presenting her notes in a different way would impact on her students' results in the end-of-year exam. In the second half of the year, rather than write her notes on the board, she presented her notes in PowerPoint, and added lots of visual cues.

Operationalised IV: ……………………

Operationalised DV: ……………………

Operational hypothesis: ……………………

……………………

……………………

……………………

**3** Dr Sing is interested in assessing whether Victorians' memory abilities decrease with age. She places an advertisement in the newspaper calling for 20- to 30-year-olds and 50- to 60-year-olds to take part in her study. She then exposes participants in both age groups to a series of memory-related tests and compares the performances of the two groups using average scores obtained from the tests.

Operationalised IV: ……………………

Operationalised DV: ……………………

Operational hypothesis: ……………………

……………………

……………………

……………………

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# 1.4 Population and sample

Experimentation is the most widely used research method for learning about human behaviour. The people used in an experiment are called participants. How the participants are selected for an experiment is very important.

## Population

A population is the entire group of people belonging to a particular category (for example, all university students or all AFL footballers). In experimental terms, it is the larger group of research interest from which a sample is to be drawn. In this context, the term *population* does not refer to the number of people living in a particular area (such as the population of Victoria), but rather a group of people with similar characteristics that are of interest to the researcher. For example, if you were to conduct a study investigating Victorian Year 12 students' favourite subjects, the population would be all students who are enrolled in Year 12 in schools in Victoria. The *sample* would then be taken from this population.


**Figure 1.4** A sample is a subset of participants taken from the population of interest.

## Sample

The process of choosing participants from the population for use in a study is called *participant selection*, or *sampling*. The group of participants in a research study are collectively called a sample. A sample is a group of participants selected from, and representative of, a population of research interest. A sample must represent the population from which it is drawn in order for inferences to be made about that population.

As a sample is always a subsection of a population, it is always smaller than the population. Ideally, psychologists would like to examine all members of the population, but this is often impossible as there may be thousands, if not millions, of people in a particular population. Therefore, testing every member of a population would take too long, and be too expensive. This is why samples are taken from the population. Samples are most commonly obtained randomly; for example, by drawing names out of a container. This gives every member of the population an equal chance of being selected for a study.

## Participant allocation

Once participants have been selected for an experiment, they must be allocated to groups within the experiment. As with sampling, the allocation (or assignment) of participants must be done in a systematic and carefully planned manner to ensure that participants' individual personality characteristics are evenly distributed among the groups. The best way to ensure that this happens is through random allocation. Random allocation is a technique that ensures that every member of the sample has an equal chance of being assigned to either the control or the experimental group. This may be done by placing the names of all members of the sample in a container and then drawing them out one by one, allocating half to each group.

A psychological experiment usually has two categories of groups: the *control group* and the *experimental group*.

The experimental group is the group (or groups) exposed to the experimental condition(s); that is, where the variable being manipulated – the IV – is present. For example, in a test of the effects of a new drug, the experimental group is the group given that drug.

The control group is the group that is exposed to the control condition; that is, where the variable under investigation is absent. For example, in a test of the effects of a new drug, the control group is often given no treatment, or is given a sugar pill or fake treatment rather than the new drug.

The control group provides a standard that the performance of the experimental group can be compared with in order to determine if the drug (IV) has had an effect on the experimental group's behaviour (DV). Without the control group, an experimenter would have no idea if the IV has had an effect on the DV or if the change would have occurred naturally or due to other factors altogether.


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## Check your understanding

**1** Complete the flow chart by defining the terms.

Population: ______

↓

Sample: ______

↓

Random allocation: ______

↙ ↘

Control group: ______

Experimental group: ______

**2** Why is it necessary to have a control group?

______

**3** If we were conducting an experiment on whether listening to music increases the enjoyment level of eating burgers at a takeaway franchise, and we wanted three experimental groups and one control group, what could each of the groups do?

Control group: ______

Experimental group 1: ______

Experimental group 2: ______

Experimental group 3: ______

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# 2 Minimising extraneous variables

## 2.1 Extraneous variables

Experiments aim to investigate a relationship between two specific variables, but often this is difficult as other variables may impact on the results. An extraneous variable (EV) is any variable *other than* the IV that causes a change in the results and therefore has an unwanted effect on the experiment. EVs often interfere with the causal link between IVs and DVs, so researchers try to prevent EVs occurring.

EVs may include differences among research participants, known as *participant variables* (for example, differences in terms of memory, motivation, mood, personality, expectations and ability); differences in how the experimenter treats the participants, known as *experimenter effects*; or differences in how the participants react to the experimental environment, known as *situational variables*.

It is an experimenter's job to ensure that EVs are minimised. There are many ways to do this, including considering how a sample is obtained and how participants are allocated to control and experimental groups, considering the experimental design that is to be used, and considering how to minimise the effect of participant and experimenter expectations. While a researcher must try to minimise the effect of EVs, sometimes EVs may be present without the researcher knowing, and they may not be identified until after the experiment is complete, if at all.

If EVs are not controlled for, they can cause a confounding effect on the interpretation of results. This means that an EV, rather than the IV, has had an effect on the results, and therefore the researcher's assumption that the manipulation of the IV alone has affected the DV may be incorrect.

When an EV has a confounding effect on the results, it is known as a confounding variable. A confounding variable is an uncontrolled variable – i.e. *not* the specified IV – that is known to have caused a change in the DV, and its effects on the results may be confused with the effects of the IV. That is, it is known that the IV alone has not caused the change in the DV. For example, when conducting a study to investigate whether boys or girls are better at maths, a researcher may take a sample of girls aged 16–17 and a sample of boys aged 14–15. In this case, it will not only be gender that affects the results; age will also play a part. In this case, age is a confounding variable because its effects will be confused with the effects of the intended IV (gender).

There are many reasons why extraneous and confounding variables may occur. One reason is artificiality; that is, the unnatural environment in which an experiment is conducted. Artificiality is commonly seen when conducting sleep studies in a sleep laboratory, because people's sleep patterns may change based on the fact that they are sleeping in an unfamiliar environment.

**Figure 2.1** Conducting research in a sleep laboratory creates problems due to artificiality.

Different types of EVs can also arise when a participant changes their behaviour during a study, so that their behaviour is not natural and therefore the results will not be accurate. These EVs are known as demand characteristics. Demand characteristics can arise when a participant's knowledge about the aims of a study impacts on their behaviour. For example, if you ask a Psychology student to take part in a recall vs recognition test, they may already know that they are likely to score better on a test of recognition, so they may try harder on the recall task in order to skew the results. Demand characteristics may also involve participants behaving in a way, or answering in a way, that they believe is desirable to the experimenter. For example, if a researcher from a company that makes Cola A asks participants if they prefer the taste of Cola A or Cola B, participants may respond that they prefer Cola A, regardless of their true feelings. Similarly, participants may make responses that they believe are socially acceptable or will be desirable for society.

Another EV can occur when there are differences in the way that a test is delivered or administered to participants – this is known as non-standardised procedures. It is therefore important to standardise each test and its procedures, which means ensuring that the test and all test conditions are the same each time the test is administered. For example, if you are testing two groups on basketball-shooting ability, you must make sure that both groups shoot in the same weather conditions, otherwise the wind or another weather factor – rather than the intended IV – may affect shooting accuracy.


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## Check your understanding

1 Identify two possible extraneous variables in each of the scenarios. Identify one that may be due to differences in the participant's characteristics and one that may be due to another type of extraneous variable.

a Kate is trying to see whether a new brand of tennis racquet improves the accuracy of a tennis serve. In her test, she uses two groups of participants on an outdoor court on Friday and Saturday nights; one group each night. The Friday-night group served with their own racquets and the Saturday-night group served with the new racquet.

EV due to participant differences: ……………………………………

……………………………………

EV due to non-standardised procedure: ……………………………………

……………………………………

b Dr Bennett has been commissioned to look at the possibility of lowering the legal blood alcohol level. He samples one group of university students on a Monday and gives them four drinks in one hour. He samples another group on a Tuesday and gives them three drinks in one hour. He then has each group take a test on a driving simulator and he counts the number of errors they make.

EV due to participant differences: ……………………………………

……………………………………

EV due to artificiality: ……………………………………

……………………………………

c Ms Luk-Tung is relatively new to the teaching profession and is interested in learning whether she is better suited to teaching boys or girls. She decides to give her two Biology classes (which contain a mix of girls and boys) a written survey in which she asks students to comment on her teaching abilities. She also asks that students write their names on the top of their surveys, so the surveys will not be anonymous.

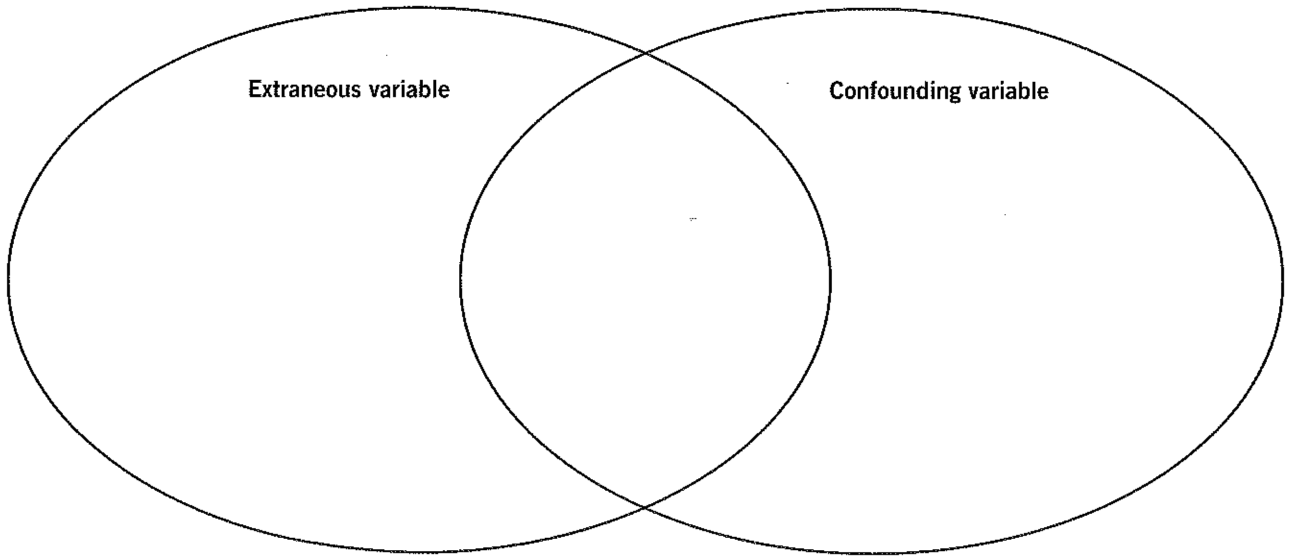
EV due to participant differences: ……………………………………

……………………………………

EV due to demand characteristics: ……………………………………

……………………………………

2 Complete the Venn diagram to show the differences and similarities between extraneous and confounding variables.

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# 2.2 Placebos and procedures

We have discussed the problem of demand characteristics, where participants' behaviour may affect the results of a study. However, we may also see a change in participants' behaviour due to their expectations.

Participant expectations can play a significant role in the way that participants behave in an experiment. Due to ethical considerations, participants will almost always be aware that they are being studied, but it is best that participants know as little about the study as possible.

## Placebos and the placebo effect

In many experimental procedures, both the control and experimental groups may receive some sort of treatment (e.g. medication); however, one group – the experimental group – will receive the actual treatment (such as a new drug) and the other group – the control group – will receive a placebo (such as a sugar pill). A placebo is a fake drug or treatment, and is used so that participants in each group do not know whether they are being exposed to the experimental condition.

The use of a placebo minimises the impact of the placebo effect on the results. The placebo effect occurs when there is a change in a participant's behaviour due to the participant's expectation about the treatment to be received. For example, consider an experiment trialling a new headache drug. If the experimenter gives the experimental group a pill and does not give the control group a pill, participants in the experimental group may believe that their headache has improved, and therefore report that it has improved, simply because they received some sort of treatment. In this case the experimenter would not be able to tell whether the reported improvement in the headache is due to the effect of the drug or the placebo effect – the effect of the participant having been given some sort of treatment. If, however, both the experimental and control groups receive a pill, every participant will believe that they are receiving treatment, which minimises the placebo effect.

## Single-blind procedures

A single-blind procedure is when the participants do not know whether they have been assigned to the control or experimental group. Placebos are used in this case, and participants are unaware of whether they are receiving the placebo (control group) or the actual drug (experimental group). This reduces the impact of participant expectations on the results.

## Double-blind procedures

A single-blind procedure may help to balance the impact of participants' expectations on results; however, the experimenters themselves still know which group is which in a single-blind procedure. The experimenter's behaviour towards these groups (such as body language, verbal cues and preferential treatment) may also influence the results of a study. This is known as the experimenter effect. The experimenter effect occurs when there is an unintentional change in participants' behaviour, and hence results, due to the experimenter's influence. For example, an experimenter may be more encouraging with the experimental group than with the control group, or may unwittingly drop hints about desired responses to help support their hypothesis.

To reduce the impact of the experimenter effect on the results, researchers may implement a double-blind procedure. This is where the participants *and* experimenter do not know which participants have been allocated to the control and experimental groups. This of course involves a third party being privy to which group is receiving the experimental treatment; however, this person is not directly involved with the participants in any way, and so cannot have any influence over them.

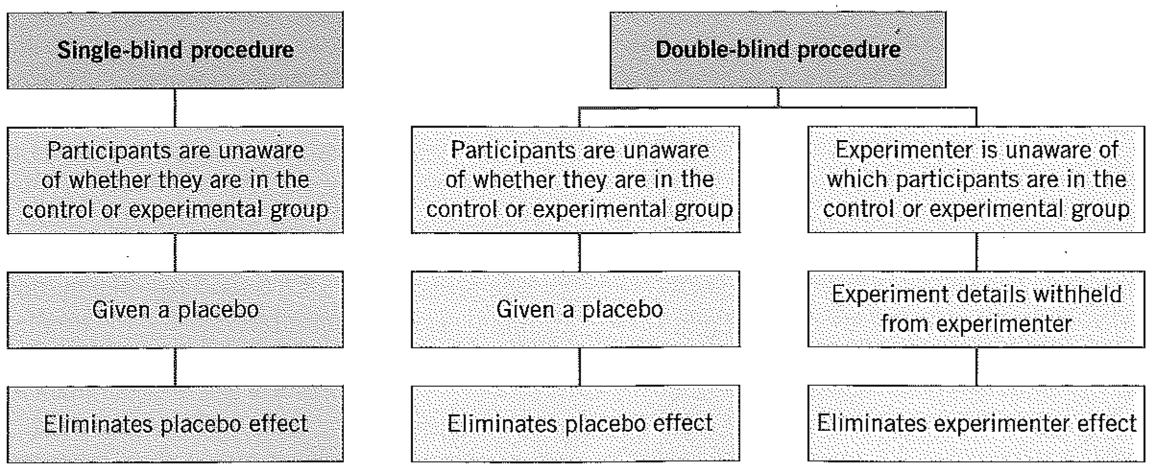


**Figure 2.2** Single-blind and double-blind procedures


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## Check your understanding

**1** Match each term with its definition.

| | |
|---|---|
| Double-blind procedure | An unintentional change in participants' behaviour, and hence results, due to the experimenter's influence |
| Experimenter effect | A fake/false drug or treatment |
| Single-blind procedure | The participants and experimenter are unaware of who is in the control and experimental groups |
| Placebo effect | The participants are unaware of who is in the control and experimental groups |
| Placebo | A change in a participant's behaviour due to their expectations of being involved in an experiment |

**2** Explain the similarities and differences between the terms in the table.

| | Similarities | Differences |
|---|---|---|
| Placebo and placebo effect | | |
| Single-blind procedure and double-blind procedure | | |

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# 2.3 Types of sampling

Psychologists use a number of different methods to sample participants for a research study. The sampling step is very important, as the main aim at the conclusion of the study is to apply the results from the sample to the larger population from which it was drawn. With this in mind, it is important that the sample is representative of the population. Sampling appropriately can also help to minimise the impact of EVs on the DV. There are many different ways to sample, including *convenience sampling*, *random sampling*, *stratified sampling* and *stratified random sampling*.

## Convenience sampling

Convenience sampling, as its name suggests, is a quick and easy way of selecting participants. It involves selecting participants based on the researcher's accessibility to them, or their availability; for example, sampling only one class in a school, or going to the local supermarket and surveying the people found there.

The main advantage of this sampling type is obvious: it is convenient. It also does not require forward planning and is quick to administer. However, this sampling technique is highly biased. Participants may not necessarily be representative of the population because they are likely to share a particular quality, or be predisposed to act in a particular way. For example, if you wanted to study personalities of school students but you sampled only a drama class at a school, those particular students may be more creative or outgoing than the rest of the school's population, so the sample may be biased.

## Random sampling

Random sampling employs a carefully planned and systematic method of selecting participants for a study. Random sampling ensures that every member of a population has an equal chance of being selected for the sample being used in the study. Two common methods of random sampling are pulling names out of a container (such as a hat), and allocating a number to each person in the population then using a random number generator to select the sample.

**Figure 2.3** A common form of random sampling is to pull names out of a hat.

The main advantages of this sort of sampling are that it is very quick and it is inexpensive, as the sampling procedures are not difficult to set up. In addition, random sampling is not biased – every member of the population has an equal chance of being selected to be part of the sample. In this way, random sampling is much more likely to be representative of the population than convenience sampling.

There is, however, the chance that the sample obtained through random sampling may not be representative of the population of research interest. Although the sample is chosen at random, by chance it may turn out that the sample is biased in one direction; for example, it may be entirely made up of men, or of people over 45 years old.

## Stratified sampling

Stratified sampling involves breaking the population into 'strata', or groups, based on characteristics they share. For example, you could divide a secondary school population into year levels; these would be the strata. Once the population is divided, you could then select participants from each strata in the same proportions that they appear in the population.

Samples chosen using this technique should be representative of the population, and there should be equal quantities of particular characteristics in the sample because the ratio of each characteristic in the sample is the same as the ratio in which it appears in the population. For example, if there are more boys than girls in a school, a stratified sample of this population would also include more boys than girls.

However, this type of sampling can be time-consuming to undertake, as information about the population's characteristics needs to be obtained before sampling can begin.

## Random stratified sampling

Random stratified sampling involves breaking the population into strata (as in stratified sampling) and then selecting the sample from each strata *randomly*. It allows a researcher to select a sample that has participant characteristics in the same proportion that they appear in the population. The difference between stratified sampling and random stratified sampling is that in random stratified sampling the sample is chosen from each strata randomly.

Random stratified sampling is advantageous in that it obtains a representative sample that is free from bias; however, it is also time-consuming to undertake.

Deciding which sampling method to use is one of the many jobs undertaken by the researcher. There are many factors to take into consideration, such as expense, accessibility and accuracy of results.


ISBN 9780170214100

## Check your understanding

**1** You want to determine the opinions of people in Victoria on water restrictions. Outline three ways in which you could obtain a convenience sample.

..........

..........

..........

**2** Your school has just decided that it will not hold a Year 12 formal this year because students were badly behaved at last year's formal. You would like to make a presentation to the principal showing the percentage of Year 12 students in the school who are against this decision. In order to gather information, you decide to have a random sample of 20 students in the school complete a survey. Outline three ways in which you could gather a random sample.

..........

..........

..........

**3** The employees of a company are having trouble agreeing on a venue for the company Christmas party. The social coordinator decides to hold a vote on preferred venues, but the company is too large to ask all employees to vote. She decides to form a stratified sample, and only members of the sample will cast a vote. Explain how she could execute this to ensure the choice of venue is fair.

..........

..........

..........

..........

**4** Complete the table by comparing the different types of sampling.

| | Convenience sampling | Random sampling | Stratified/Random stratified sampling |
|---|---|---|---|
| How are participants sampled? | | | |
| Advantages of this method | | | |
| Disadvantages of this method | | | |

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# 2.4 Experimental research designs

As we learned earlier, the third step in psychological research is to decide on the experimental design that will be used; that is, how the participants will be allocated to groups within the experiment. There are several different experimental designs that can be implemented, and careful consideration of the experimental design is another way to minimise extraneous variables.

## Independent-groups design

The independent-groups design involves randomly allocating the members of the sample to either the control or experimental group. Once you have your sample, you may draw participants' names randomly out of a container and assign the first name to the control group, the next name to the experimental group and so on until all participants are assigned to groups. The independent-groups design is a very quick and easy design to administer, and is therefore a popular technique in experimentation. It allows us to research large numbers of participants fairly easily.

The two groups in an independent-groups design should be free from bias but, due to the random nature of group assignment, there may be participant differences between the two groups; for example, members of one group may by chance be naturally smarter than members of the other group. This design does not, therefore, effectively minimise differences in participant characteristics between the two groups.

## Matched-participants design

The matched-participants design seeks to eradicate participant differences. The matched-participants design involves pairing each participant based on a certain characteristic that they share; for example, you may pair the two smartest students or the two most experienced netballers. Once you have matched these participants, you randomly allocate one to the control group and one to the experimental group. This helps to achieve an even spread of participant characteristics between the two groups, and hence minimises extraneous variables due to participant differences. For this reason, identical twins are often ideal candidates for a matched-participants design.

One limitation of this design is that it involves a pretest to match participants on particular characteristics (for example, you may administer an IQ test to match participants on intelligence) and is therefore more time-consuming than other designs. Also, during experimentation one participant may drop out, and in a matched-participants design this means that the other member of the pair (in the other group) must also be removed from the study.

## Repeated-measures design

Although a matched-participants design seeks to ensure that both groups are equal in participant characteristics, it does still use different participants and hence there may be natural differences in their abilities. A repeated-measures design is implemented by using only one group of participants and exposing that group to both the control and experimental conditions. As the same participants are used in the control and experimental conditions, they are obviously completely identical in characteristics and abilities.

This experimental design eliminates the impact of participant differences as an EV but it does create a different problem known as order effects. Order effects occur when there is a change in results due to the sequence in which two tasks are completed; that is, due to the order in which participants complete the control and experimental conditions. The change in results may be an increase in performance due to knowledge or experience in a task, or may be a decrease in performance due to boredom or fatigue with carrying out a task more than once. An individual's experience may therefore have an impact on the results of the study and this would be an extraneous variable.

For example, you may be involved in a repeated-measures study that investigates how different bathing suits affect swimming speed. You undertake the control condition first, in which you wear your normal bathers, and the experimental condition second, in which you wear a special bathing suit. The IV is supposed to be the type of bathing suit worn, but your performance in the experimental condition may be altered because you have already completed the control condition: it may be enhanced because you have had a warm-up swim, or it may be hindered because the first swim exhausted you. In this case, swimming performance may be due to factors other than the IV, and this is an example of order effects.

One way to minimise the impact of order effects is to use counterbalancing. Counterbalancing involves dividing the group of participants in half and arranging the order of the conditions so that each condition occurs equally as often in each position. That is, it involves exposing half of the participants to the control condition first and the experimental condition second, and exposing the other half to the experimental condition first and the control condition second. This counterbalances the potential impact of order effects on the results. In the swimming example, half of the participants would swim in their own bathers first and the new bathing suit second, while the other half would swim in the new bathing suit first and their own bathers second.


ISBN 9780170214100

## Check your understanding

**1** Complete the table by comparing the different experimental designs.

| | Explanation | Advantage(s) | Disadvantage(s) |
|---|---|---|---|
| Independent-groups design | | | |
| Matched-participants design | | | |
| Repeated-measures design | | | |

**2** You would like to investigate whether drinking an energy drink helps individuals to remember a list of 50 three-letter words. You decide to expose all your participants to a control condition, where participants will learn List A and then recall as many words as possible; and an experimental condition, where they will learn List B while drinking an energy drink and then recall as many words as possible.

**a** Which experimental design has been used in this experiment? Explain your answer.

.................................................................

.................................................................

**b** Provide two examples of order effects that may impact on the results of this study.

.................................................................

.................................................................

**c** Explain how you could use counterbalancing in this experiment to eliminate the impact of order effects on the results.

.................................................................

.................................................................

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# 3 Collecting and presenting data

## 3.1 Data collection

In their search for accurate information, psychologists gather evidence in many ways. Sometimes they use experimental techniques, but sometimes they use other, non-experimental, techniques.

### Case studies

A case study is an in-depth or detailed study on a single person or small group of people. It allows researchers to gain very specific information about a particular occurrence or phenomenon. However, case studies are not an ideal research technique, as they can be time-consuming to undertake and it is difficult to generalise findings from one person to the wider population.

Twins provide an excellent basis for case study research in psychology. When investigating the impact of nature versus nurture, identical twins provide fascinating insight into the debate. For example, case studies of twins who are reared apart, through circumstances such as adoption, allow insight into the impact of the environment on a child's development.

Case studies are often conducted by investigating a group of people over a period of time in what is known as a longitudinal study.

### Observational studies

An observational study involves an individual observing another individual or a group of people in a natural environment, and recording observations about the behaviour they witness. The observer only records overt, observable behaviour. Observational studies are advantageous in that they eliminate the extraneous variable of artificiality; however, they rely upon an observer's interpretation of events. This means that the recordings are subject to observer bias, where the observer sees what they want or expect to see, and this may result in a biased representation of the behaviour. Observational studies are often cross-sectional studies, whereby a researcher seeks to investigate two or more samples of participants at the same point in time.

### Self-reports

When individuals are asked to comment on their own thoughts, emotions and beliefs by answering a series of questions on a particular topic, this is known as a self-report. Self-reports allow researchers to collect subjective data that cannot be overtly seen or measured, and hence gain insight into the reasons behind behaviours. The use of self-reports can make it difficult to compare data between participants due to their subjective nature.

There are many different types of self-reports, including surveys and questionnaires, where participants respond to a series of verbal or written questions. These questions can be open-ended (where participants are free to comment without limitation) or close-ended (where participants may choose an answer from alternatives or are restricted in their choices). A rating scale involves individuals choosing the statement or the rating that best describes their opinion or attitude on a particular topic; this is a close-ended format. A common form of rating scale is the Likert scale, in which participants are asked to choose a response to a statement on a scale from 'strongly agree' to 'strongly disagree'.

Interviews are another way of collecting self-report data; these involve face-to-face or telephone contact in which questions are asked and answered. Interviews may be structured (asking a planned series of questions) or unstructured (conversation-like and open to change). Interviews are not very time-efficient because the execution of the interview and subsequent collation of data can take a long time. However, they are an excellent way to gain detailed responses that can be explored in greater depth.

### Brain imaging and recording technologies

Brain imaging and recording technologies are scientific technologies that involve gaining structural or functional images of an active brain. Brain imaging devices include (for example) CT scans or MRIs, which take X-ray images of the brain on multiple axes to look at the structure of the brain; or fMRIs, which allow researchers to observe an active brain by measuring changes in blood–oxygen levels, to identify the areas that are most active when completing different tasks.

These technologies provide highly specific information about the brain and its functions; however, they are expensive to use and findings can be difficult to generalise to the wider population, as no two brains are exactly alike.


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## Check your understanding

Explain which data-collection technique is being illustrated in each case, and provide one advantage and one disadvantage of each technique.

**1**

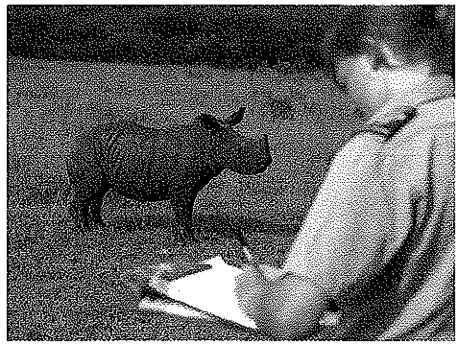
| **Name:** ______________ | **Age:** _____ |
|---|---|
| 1 Do you enjoy any of the following activities? (Circle all those that apply.) | |
| Cycling | Walking |
| Horse-riding | Aerobics |
| Dancing | Reading |

**a** What data-collection technique is identified? ......................

**b** Advantage of this form of data collection: ......................

**c** Disadvantage of this form of data collection: ......................

**2**



**a** What data-collection technique is identified? ......................

**b** Advantage of this form of data collection: ......................

**c** Disadvantage of this form of data collection: ......................

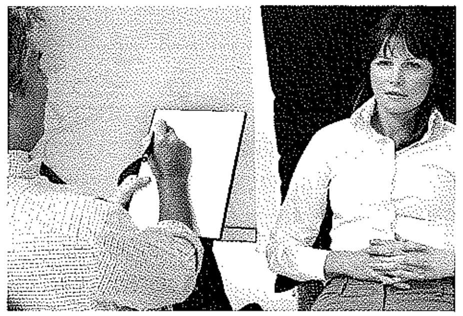
**3**

**a** What data-collection technique is identified? ......................

**b** Advantage of this form of data collection: ......................

**c** Disadvantage of this form of data collection: ......................

**4**



**a** What data-collection technique is identified? ......................

**b** Advantage of this form of data collection: ......................

**c** Disadvantage of this form of data collection: ......................

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# 3.2 Types of data

Once the participants have been sampled and the experiment has been designed, the experimenter is ready to start the experimentation phase and gather data. Data are the information (observable facts) that psychologists systematically collect in experiments, studies and investigations. Another name for data is empirical evidence; that is, the information psychologists gain from direct observation and measurement. Examples of data range from people's attitudes about political issues to participants' results on an intelligence or personality test. Data are used by researchers as evidence to support their findings or to formulate predictions about future studies.

There are a number of different types of data.

## Subjective vs objective data

Subjective data are data collected through observations of behaviour, or information based on participants' self-reports. Subjective data are often biased because they require personal information (such as attitudes or opinions) to be given and, because of this, subjective data can be difficult to statistically analyse. An example of subjective data would be data generated by someone observing the behaviour of children in a playground. If the observer sees a child throw a ball at another child, the observer might interpret this as aggressive. However, the child who threw the ball may have delayed motor abilities and may have hit the other child with the ball accidentally; so the action looked aggressive but it was in fact innocent. The data collected in such a situation is based solely on the observer's interpretation, and the facts of the situation are not known. The data is therefore subjective.

**Figure 3.1** Data obtained by interpreting a child's behaviour in a playground is known as subjective data.

Objective data are data collected under controlled conditions and are easily measured and compared with other data. These types of data are often in numerical form and can be statistically analysed. An advantage of objective data is that it minimises many biases encountered in research. An example of a piece of objective data would be running speed, the height of a person or the number of siblings someone has.

Both of these data types have limitations. Subjective data can provide great insight into a person's opinions and beliefs, but researchers need to be aware that such data are difficult to compare with other data. If one person says on a depression scale that they are feeling '4 out of 10' and another person says they feel '6 out of 10', it cannot be assumed that the individual with the lower rating is the more depressed. Objective data, on the other hand, while very easy to compare, do not always provide reasoning behind the score because external factors are not taken into account. For example, in a 100-metre running race, Person A may record a faster time than Person B, and we would conclude from the objective data (time recorded) that Person A is faster. However, the objective data do not account for other factors that may have contributed to the result of the race, such as injury or exhaustion, or the type of footwear worn.

## Qualitative vs quantitative data

Qualitative data are data that describe changes in the quality of behaviour, and are often expressed in words. Data such as this are difficult to categorise or statistically analyse because responses could take a wide variety of forms and are open to personal, observer or researcher biases. An example of qualitative data would be participants' descriptions of a film they had seen. Every participant would describe the film in a slightly different way, would have different ways of interpreting the plot, and would have their own unique feelings about and reactions to the film. Such information is difficult to quantify.

Quantitative data take a numerical or categorical form, and can be statistically analysed and readily measured and compared with other data. An example of quantitative data is the number of words recalled correctly from a list or a score on an intelligence test.

Qualitative data have many similarities to subjective data, as they are both opinion-based. Participants can be completely unrestricted in their responses and can provide great insight into why they feel a particular way. However, like subjective data, this is often difficult to summarise or compare with other data.

Quantitative data are similar to objective data in that researchers can easily draw conclusions from them and use them to make comparisons to other data. Quantitative data also share limitations with objective data, in that quantitative data restrict participants from providing explanations and leave little scope for participants to elaborate on their responses.


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## Check your understanding

**1** State whether the types of data are objective or subjective and qualitative or quantitative.

| Types of data | Objective/Subjective | Qualitative/Quantitative |
|---|---|---|
| Hair colour | | |
| Number of hours spent watching TV per day | | |
| What people see in an inkblot test | | |
| Descriptions of why students like doing homework | | |
| Average height of students in a Year 10 class | | |

**2** You are interested in gathering the opinions of students at your school regarding compulsory wearing of uniforms. You don't want to restrict students' responses, so you decide to collect qualitative data.

**a** How could you collect this data to ensure that they are qualitative?

**b** What is one disadvantage of this type of data?

**c** The principal would like to be able to compare students' opinions easily, so she asks you to redo your study and collect quantitative data. How could you collect quantitative data on this topic?

**d** You present your quantitative results to the principal, who argues that although the data is quantitative, it is still subjective. How could that be?

**e** The principal decides to make school uniforms optional, but would still like to assess the students' preference for uniforms or casual dress. How could she gather objective data about this in the coming weeks?

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# 3.3 Descriptive statistics

On their own, raw data are meaningless, because they have not been organised and hence are difficult to interpret. Raw data are organised using descriptive statistics. Descriptive statistics are used to summarise, organise and describe data obtained from research. This allows the data to be more easily interpreted.

Descriptive statistics include *percentages*, *graphs* and mathematical calculations such as *measures of central tendency*.

## Percentages

A percentage illustrates the proportion of the sample that displays a particular behaviour; for example, 75 per cent of Year 12 students turn 18 in their final year of school, or 62 per cent of adolescents watch reality TV.

Using a percentage is a quick and effective way to compare the results of two different groups in a study. It is calculated by dividing the number of people that display a particular behaviour by the total number in the sample, and multiplying the result by 100.

## Measures of central tendency

Measures of central tendency involve a calculation that shows how typical scores, or a majority of scores, fall in a data set. There are three measures of central tendency: mean, median and mode.

The mean is a commonly used measure whereby all of the scores in a data set are added together and then divided by the total number of pieces of data. The mean represents the average score in a data set. The mean score is an example of a sample statistic. Sample statistics are numbers that describe the behaviour or characteristics of a sample drawn from a larger population.

A limitation of using the mean is that it can be greatly influenced by a very large or very small score in the data set, known as an outlier. Outliers skew the representation of the data. For example, if you were considering the mean age of people in your Psychology class, the age of your teacher would be an outlier that could skew the results, as it would be higher than the average age of the students.

The median is the middle number in a data set. It is calculated by arranging all of the data from smallest to largest and then selecting the piece of data in the middle. The median is commonly used when reporting VCE results, as it is not affected by outliers in a data set. If there is an even number of pieces of data in a data set, the mean of the middle two numbers is the median.

The mode is the final measure of central tendency and reflects the most commonly occurring number within a data set. The mode can be useful in seeing which score occurs most often, but it can be an unreliable measure for small samples.

| |
|---|
| Data set (scores on a test):<br>72, 73, 73, 78, 84, 85, 86, 90, 90, 90, 94, 96 |
| Mean $= \frac{72+73+73+78+84+85+86+90+90+90+94+96}{12}$<br>$= 84.25$ |
| Median $= \frac{85+86}{2}$<br>$= 85.5$ |
| Mode = 90 |

**Figure 3.2** Calculating measures of central tendency

## Spread of scores

Another way of describing data is by looking at how the data are spread. This is known as variability. One measure of a data set's variability is the range. The range of data can be calculated by subtracting the lowest score from the highest score.

Another measure of variability is standard deviation. Standard deviation explores variability of data by looking at how far each individual piece of data differs from the mean. A low standard deviation indicates that scores are clustered around the mean and hence there is low variability in that set of scores. A high standard deviation indicates that scores are spread out from the mean and hence there is high variability in that set of scores.

## Using descriptive statistics

There are many other ways in which data can be described. The problem with descriptive statistics is that they only describe the data. For example, they can tell us which teaching method produced better scores on a test or whether chewing gum while studying produced higher scores on a memory task than not chewing gum, but they cannot tell us whether the difference between two scores is large enough to attribute to the independent variable or whether this difference occurred due to chance. In other words, descriptive statistics do not establish whether there is a cause-and-effect relationship between the variables.



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## Check your understanding

**1** Below is the number of points each of the 10 members of a basketball team scored in the final game of the season.

| Player no. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No. of points | 21 | 14 | 7 | 7 | 7 | 6 | 6 | 4 | 2 | 0 |

**a** What is the mean number of points scored by each player?

**b** What is the median number of points scored by each player?

**c** What is the mode for points scored by each player?

**d** What do you believe is the best measure of central tendency to represent the point-scoring of this team? Why?

**e** What percentage of the total goals did Player 1 score for her team (to the nearest whole number)?

**f** Can we conclude that Player 1 is the team's best shooter? Explain your answer.

**2** Sarah and Maeve are in two different Psychology classes at school, and they are discussing which class has done better on their recent assessment task. Both classes gained the same mean but achieved very different results. Their classmates' results are in the table below.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sarah's class | 21 | 28 | 13 | 30 | 7 | 12 | 26 | 25 | 18 | 28 |
| Maeve's class | 26 | 23 | 24 | 26 | 22 | 20 | 24 | 19 | 21 | 22 |

**a** Calculate the range of the scores in Sarah's class.

**b** Calculate the range of the scores in Maeve's class.

**c** How would you describe the variability of scores in both classes?

**d** Can you conclude that one class has performed better than the other? Explain your answer.

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# 3.4 Visual representations of data

## Sorting data

A simple way of organising data, especially if you have a large amount, is to use a frequency distribution table. The categories being compared are placed in one column of the table. If there are several different categories, you may put them in groups, or class intervals, and then count how many times a piece of data fits into each interval. This is referred to as *frequency*.

Table 3.1 Raw scores in a hypnotic susceptibility test

55, 86, 52, 17, 61, 57, 84, 51, 16, 64, 22, 56, 25, 38, 35, 24, 54, 26, 37, 38, 52, 42, 59, 26, 21, 55, 40, 59, 25, 57, 91, 27, 38, 53, 19, 93, 25, 39, 52, 56, 66, 14, 18, 63, 59, 68, 12, 19, 62, 45, 47, 98, 88, 72, 50, 49, 96, 89, 71, 66, 50, 44, 71, 57, 90, 53, 41, 72, 56, 93, 57, 38, 55, 49, 87, 59, 36, 56, 48, 70, 33, 69, 50, 50, 60, 35, 67, 51, 50, 52, 11, 73, 46, 16, 67, 13, 71, 47, 25, 77

Table 3.2 Frequency distribution table of scores in a hypnotic susceptibility test

| Class interval (scores) | Number of people in class interval |
|---|---|
| 0–19 | 10 |
| 20–39 | 20 |
| 40–59 | 40 |
| 60–79 | 19 |
| 80–99 | 11 |

## Graphing data

A graph enables large amounts of information to be neatly organised and summarised, and can show how one variable relates to another.

A histogram is a type of graph made by placing class intervals on the horizontal (*x*) axis, and the frequency on the vertical (*y*) axis (see Figure 3.3). A histogram has each of its bars touching, and is used to represent data that is continuous; that is, each piece of data is related to the next.

A histogram can be adapted into a frequency polygon. This is a graph of a frequency distribution in which the number of scores falling into each category is plotted as a point on the graph, with lines being drawn to connect the points. A frequency polygon joins the mid-points of a histogram. A frequency polygon begins and ends with a point on the *x*-axis, whereas other line graphs do not necessarily start and end at zero. A frequency polygon is a type of line graph, which is any single line that connects points that relate one variable to another.

Alternatively, some data that is graphed may not be continuous. For example, you may need to compare methods used for weight loss. Each method is not on a continuum of

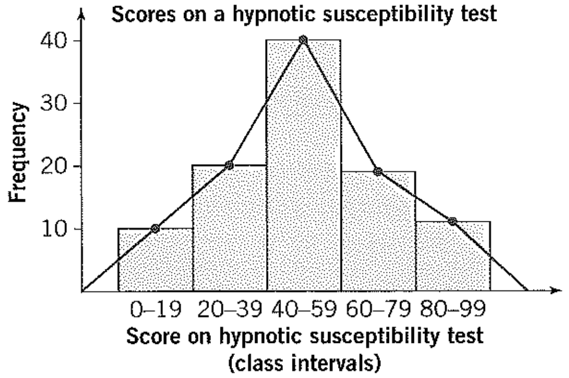


Figure 3.3 A frequency histogram and frequency polygon

possible methods, and no two methods have a relationship to each other, so the categories you are comparing are not continuous. This is known as discrete data. The type of graph used to represent discrete data is a bar graph, which is essentially a histogram in which the bars do not touch.

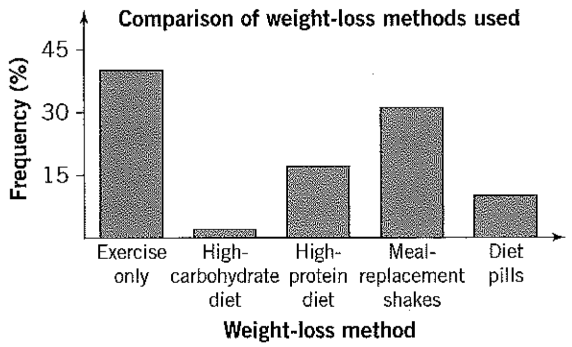


Figure 3.4 A bar graph

The data above could also be displayed using a pie chart. A pie chart shows the representative characteristics or opinions of subsets of a sample as a proportion of the entire population. To construct a pie chart, the data must be converted into percentages of the total sample, and then converted into degrees of a circle.

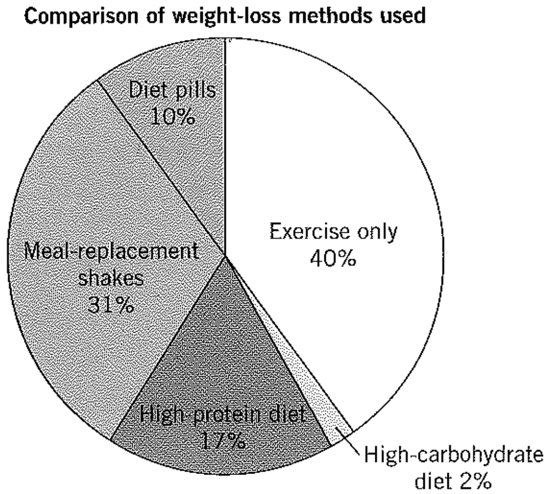


Figure 3.5 A pie chart


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## Check your understanding

**1** Sam is working as a statistician for his local hockey club. He has been assessing the *average* number of goals scored by each of the club's players across the last season.

The raw data, rounded to the nearest goal, is recorded at the right.

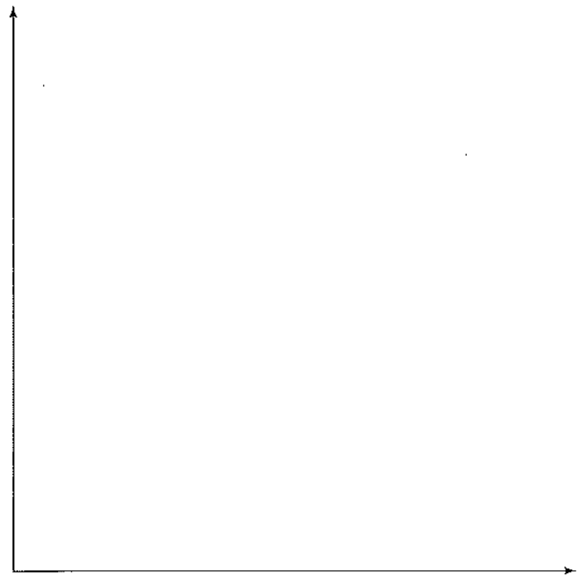
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 4 | 3 | 2 | 0 | 3 | 6 |
| 8 | 2 | 0 | 0 | 1 | 6 | 4 | 2 |
| 3 | 0 | 0 | 11 | 1 | 3 | 1 | 1 |

**a** Complete the frequency distribution table below to organise the data.

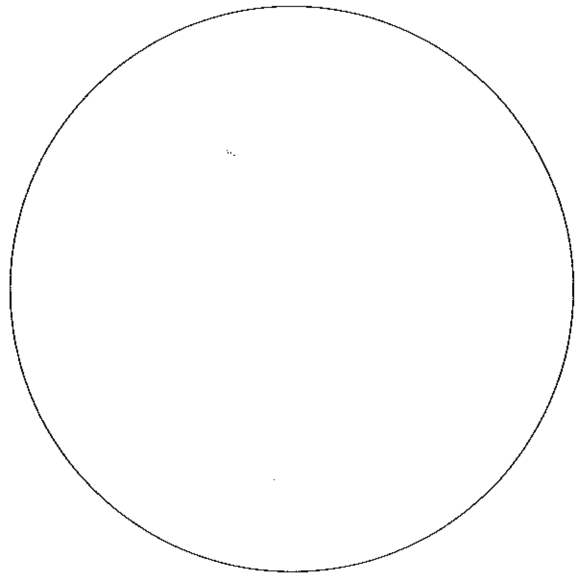
| Class interval (Average no. of goals) | Frequency |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

**b** Is the data represented in the frequency distribution table continuous or discrete? Explain.

**c** Based on your answer to part **b**, graph this data on the axis below in the most suitable manner. Remember to label both axes.



**d** Calculate the percentage in which each class interval appears in the data set of soccer goals. Roughly sketch a pie chart of the information. (Round the degrees to whole numbers to make it easier to sketch the pie chart. Use the space at the bottom of this page for your calculations.)



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# 3.5 Frequency distribution curves

A frequency distribution curve is a curve that shows the spread of a set of scores over equally-sized intervals.

A typical frequency distribution curve has a majority of scores placed around the mean, with tails at both ends representing a minority of very high or very low scores. Below is a typical bell-shaped curve that demonstrates the spread of scores for IQ. As you can see, a majority of the population has IQ scores between 90 and 110.

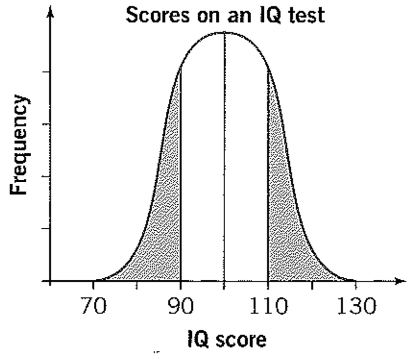


Figure 3.6 A typical bell-shaped curve

A bell-shaped curve may show that a data set has high variability (a lot of spread in the scores from the mean or mid-point) or low variability (little spread in the scores from the mean or mid-point). For example, when investigating ages of students in Year 12 there would likely be low variability in that data set; however, when looking at the ages of teachers in a school, there would likely be high variability.

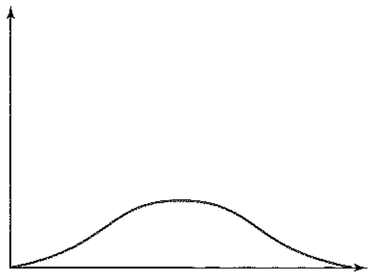

Figure 3.7 A bell-shaped curve that demonstrates high variability

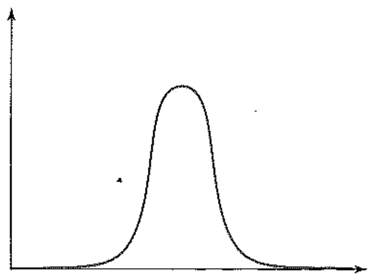

Figure 3.8 A bell-shaped curve that demonstrates low variability

Bell-shaped curves can also be skewed. If there are more high scores than low scores in a data set, a frequency distribution curve will be negatively skewed. You may see a negatively skewed curve when plotting the results of giving Grade 6 students a Grade 4 maths test. If there are more low scores than high scores in a data set, a frequency distribution curve will be positively skewed. You may see a positively skewed curve when plotting the results of giving Year 11 Psychology students a university Psychology exam. It is the skew of the data in VCE subjects that helps administration to decide the scaling of each individual subject.

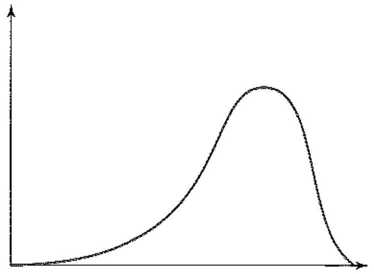

Figure 3.9 A bell-shaped curve that demonstrates negative skew

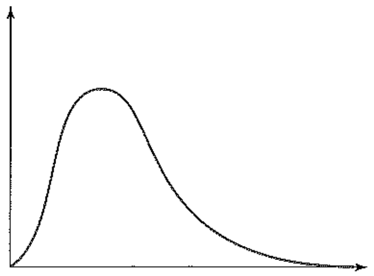

Figure 3.10 A bell-shaped curve that demonstrates positive skew

There may also be two mid-points in a data set. In this case the distribution curve may show bi-modal distribution, and scores are distributed around the two different mid-points. This may be seen, for example, when looking at heights of Grade 6 students, as there will be a typical height for males and typical height for females.

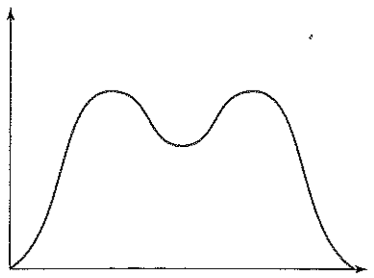

Figure 3.11 A bell-shaped curve that demonstrates bi-modal distribution


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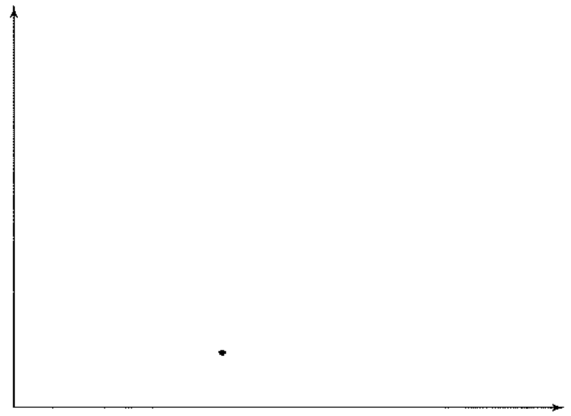
## Check your understanding

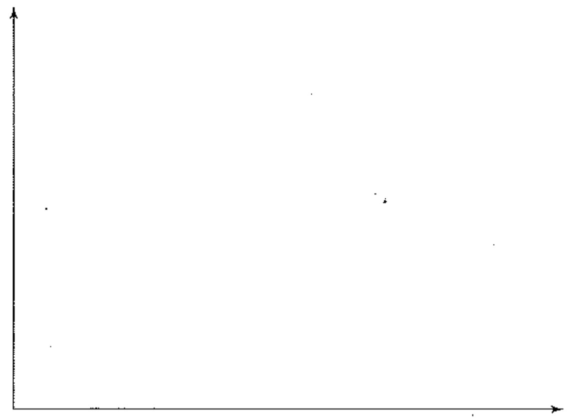
**1** Sketch each frequency distribution curve on the axes provided.

**a** A typical distribution curve with high variability

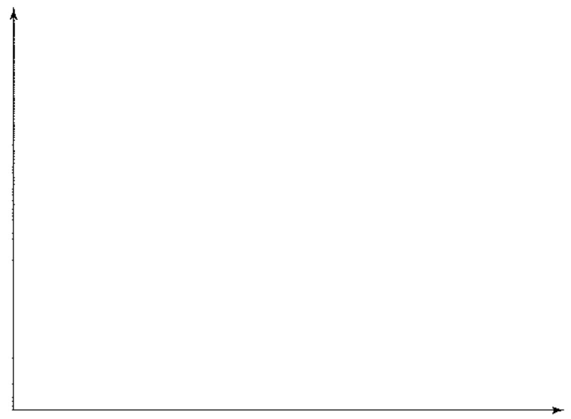
**b** A positively skewed curve



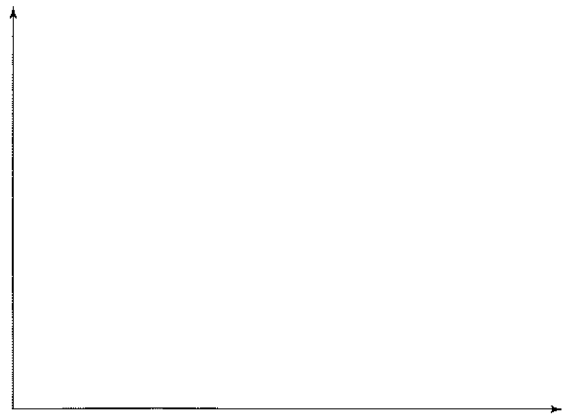
**c** A typical distribution curve



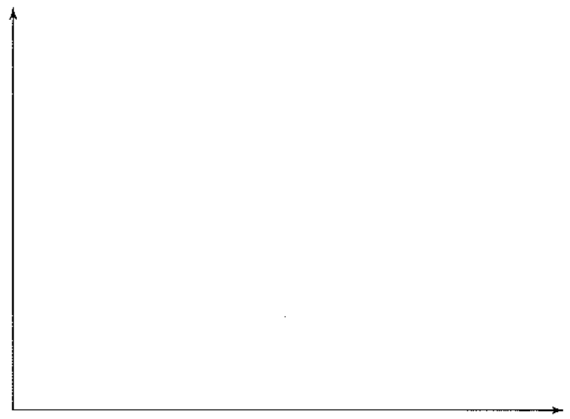
**d** A negatively skewed curve



**e** A bi-modal distribution curve



**f** A typical distribution curve with low variability



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# 3.6 Correlation

Some experiments ultimately seek to establish a cause-and-effect relationship between two variables; however, correlation studies simply seek to establish whether two variables are related at all. Note that correlation *does not* seek to imply causation.

Correlation is displayed visually, on a graph known as a scatterplot, and numerically, as a correlation co-efficient. A *scatterplot* is a graph that shows an individual dot for each piece of data. The *correlation co-efficient* is a number that describes the strength and direction of the correlation. One way to ascertain the correlation co-efficient is by analysing where all of the dots fall on a scatterplot.

## Direction

A positive correlation occurs when both variables increase or decrease in relation to each other. This may be seen, for example, when investigating driver speed and number of car accidents if it is found that, as speed increases, so does the number of accidents. Positive correlation is expressed as a correlation co-efficient between 0 and 1.

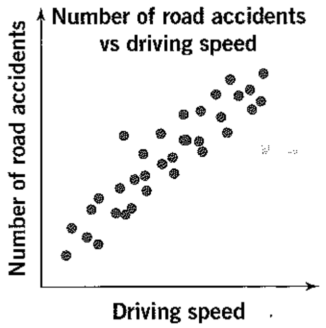


**Figure 3.12** Scatterplot demonstrating positive correlation

A negative correlation occurs when, as one variable increases, the other one decreases, or, as one variable decreases, the other variable increases. This may be seen, for example, when investigating the relationship between exercise and weight, if it is found that weight decreases as exercise increases. Negative correlation is expressed as a correlation co-efficient between −1 and 0.

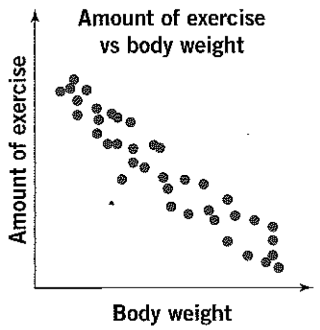


**Figure 3.13** Scatterplot demonstrating negative correlation

## Strength

If the dots on a scatterplot can be joined to form a straight line, this is known as perfect correlation. This is as strong as a relationship between two variables can get. As such, if the line is in the positive direction, it is assigned the correlation co-efficient of 1; if the line is in the negative direction, it is assigned the correlation co-efficient of −1. A strong correlation may be seen if the dots are close to forming a line or are tightly bunched together around one line. Strong positive correlations may be expressed as 0.7 to 0.9, whereas strong negative correlations may be expressed as −0.7 to −0.9. As the relationship becomes weaker, the correlation co-efficient will approach zero, and the dots will get further apart. If there is no relationship between variables, this is known as zero correlation and is given the correlation co-efficient of 0; the dots in such a scatterplot would be randomly placed.

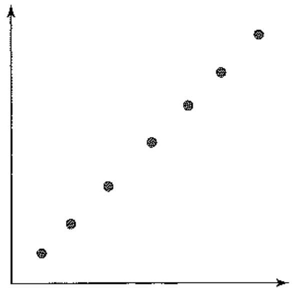

**Figure 3.14** Correlation co-efficient = 1

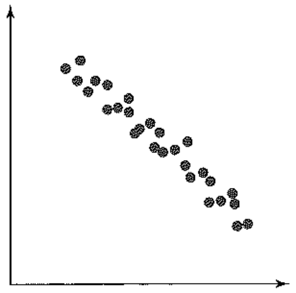

**Figure 3.15** Correlation co-efficient = −0.8

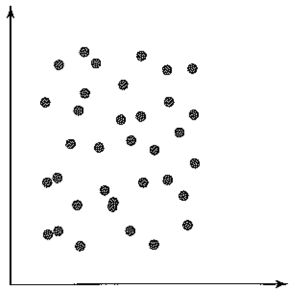

**Figure 3.16** Correlation co-efficient = 0



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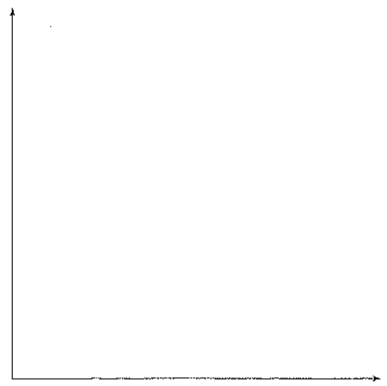
## Check your understanding

**1** The table shows a comparison between each AFL team's final position after round 16 in the 2010 season, and the average number of games played per player in each team throughout their football career, as at round 16 2010.

**a** Use these data to plot the correlation between the two variables.

| Club | Ladder position | Average number of games played per player (in career) |
|---|---|---|
| Collingwood | 1 | 96.6 |
| Geelong | 2 | 122.5 |
| St Kilda | 3 | 103.6 |
| Fremantle | 4 | 68.1 |
| Western Bulldogs | 5 | 107.8 |
| Sydney | 6 | 91.8 |
| Hawthorn | 7 | 84.7 |
| Carlton | 8 | 60.7 |
| North Melbourne | 9 | 57.7 |
| Adelaide | 10 | 87.5 |
| Melbourne | 11 | 63.8 |
| Essendon | 12 | 59.3 |
| Brisbane | 13 | 85.6 |
| Port Adelaide | 14 | 73.9 |
| Richmond | 15 | 54.3 |
| West Coast | 16 | 53.0 |

Source: *Bigfooty.com*, http://www.bigfooty.com/forum/showthread.php?t=733106



**b** How would you describe the direction and strength of this correlation?

**c** What is the problem with a situation such as a sporting ladder, where the most successful team has the lowest number (the top position) and the least successful team has the highest number (the bottom position)? Would the correlation look different if the most successful team 'scored' position 16 and the least successful team 'scored' position 1?

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# 4 Drawing conclusions

## 4.1 Inferential statistics

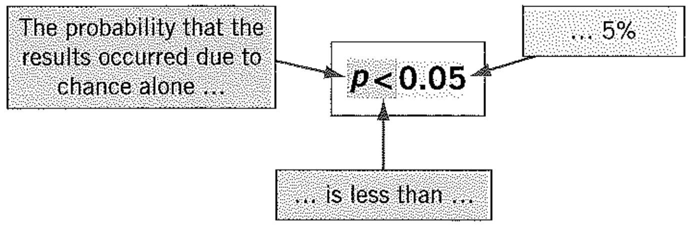
Typically, psychologists seek to discover general patterns of behaviour that apply widely to humans. For example, a researcher studying the effects of a new therapy on a small group of people suffering from depression would like to know if the therapy holds promise for *all* people with depression. Inferential statistics allow us to make inferences about the results of an experiment; to form *conclusions* and *generalise* findings; that is, to apply findings about the behaviour of small groups (samples) to the larger groups they represent (populations).

Experimenters use inferential statistics to determine whether or not the results of an experiment support the hypothesis. The researcher must also determine whether differences between results yielded by the experimental and control groups are due to manipulation of the IV, or to chance. For example, if students in Ms Perfect's class outperformed students in Ms Lanati's class, could we simply conclude that Ms Perfect is the better teacher? Inferential statistics allow us to determine whether other factors are involved.

Statistical significance refers to the *significance* of the difference between two scores; that is, whether we can attribute the results to the IV or to chance alone. Therefore, inferential statistics allow us to infer a cause-and-effect relationship between two variables; something that descriptive statistics do not allow.

### *p*-value

Before conducting an experiment, researchers set what is known as a *p*-value. A *p*-value is the level of probability that the results are due to chance alone, and determines statistical significance. In Psychology, it is typical to set a *p*-value at $p < 0.05$, which means that, for the results of a study to be statistically significant, the probability that the results are due to chance must be less than 5%.




When results are obtained, they must be tested for their statistical significance. Tests of significance include *t*-tests and chi-square tests. We will not investigate the tests here, but both allow researchers to determine the *p*-value for a particular set of results, and hence whether the results are statistically significant. If the *p*-value for the experiment is set at $p < 0.05$, the results of that experiment, when tested for significance, must be $p < 0.05$ in order for them to be deemed statistically significant.

If the results are found to be statistically significant, it is likely that the IV caused the change in the DV. This would support the experiment's hypothesis, and conclusions and generalisations could be made from the study. If the *p*-value is greater than (>) 0.05, the results are not statistically significant, and the results are likely to be due to chance and not to the IV. Hence, the hypothesis is rejected and no conclusions can be drawn.

A *p*-value may be set lower (for example, at $p < 0.01$) for very important studies, such as when trialling medical drugs.

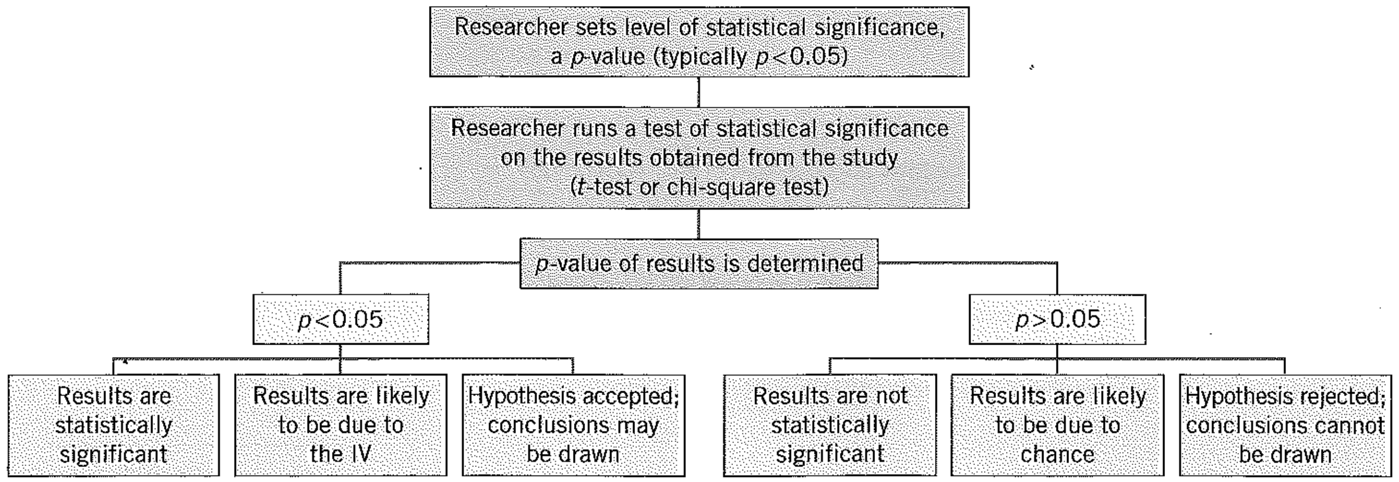



**Figure 4.1** Determining statistical significance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## Check your understanding

For each experiment below, the *p*-value set at the beginning of the experiment was $p < 0.05$.

**1** Experimenters conducted research investigating a link between frequency of meditation and length of sleep. A test of significance on the results was found to be $p \leq 0.05$.

**a** This means that the probability that the results occurred due to chance is:

..............................................................................................

**b** This means that (tick the appropriate endings to the sentence):

| | | | |
|---|---|---|---|
| | the results are statistically significant | | the results are not statistically significant |
| | the independent variable has caused a change in the dependent variable | | the independent variable has not caused a change in the dependent variable; chance factors have caused the change |
| | a conclusion may be drawn | | no conclusion can be drawn |

**2** Experimenters conducted research investigating a link between birth order and intelligence. A test of significance on the results revealed that $p > 0.05$.

**a** This means that the probability that the results occurred due to chance is:

..............................................................................................

**b** This means that (tick the appropriate endings to the sentence):

| | | | |
|---|---|---|---|
| | the results are statistically significant | | the results are not statistically significant |
| | the independent variable has caused a change in the dependent variable | | the independent variable has not caused a change in the dependent variable; chance factors have caused the change |
| | a conclusion may be drawn | | no conclusion can be drawn |

**3** Experimenters conducted research investigating the impact of driving lessons on driving test scores. A test of significance on the results showed that $p < 0.01$.

**a** This means that the probability that the results occurred due to chance is:

..............................................................................................

**b** This means that (tick the appropriate endings to the sentence):

| | | | |
|---|---|---|---|
| | the results are statistically significant | | the results are not statistically significant |
| | the independent variable has caused a change in the dependent variable | | the independent variable has not caused a change in the dependent variable; chance factors have caused the change |
| | a conclusion may be drawn | | no conclusion can be drawn |

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# 4.2 Validity and reliability

There are many factors to consider before the results of one experiment can be applied to the broader population. One of the responsibilities of the researcher is to ensure that the methods they are using to test and assess the impact of the IV on the DV are valid and reliable.

Validity refers to the extent to which an assessment tool actually measures what it is designed to measure. For example, if you design an IQ test, it must actually assess general knowledge and abilities, not just mathematical understanding. Reliability refers to the extent to which an assessment tool measures what it is supposed to measure consistently, each time it is used. For example, if a person takes the same IQ test multiple times, they would achieve the same score each time if it was reliable.

## Comparing validity and reliability

We can liken the concepts of validity and reliability to playing darts. A test with high validity and low reliability can be likened to hitting the dartboard with all the darts, but not hitting it in the same spot.

In contrast, a test with high reliability and low validity can be likened to hitting the wall in the exact same spot with each dart, but missing the dartboard altogether.

## Types of validity and reliability

There are many different ways of assessing validity and reliability. Research investigations can have *internal* validity and reliability (in terms of the instruments and research tools being used within an investigation) or *external* validity and reliability (in terms of applying findings to and using tools on the population).

Researchers strive towards most of these types of validity and reliability, but may not always strive towards *criterion-related validity*, as the point of much research is to find out something new, not simply replicate the findings of others.

| | Internal | External |
|---|---|---|
| **Validity** | Content validity – Are the instruments or research tools assessing what they are supposed to assess? (For example, is an IQ test actually assessing general intelligence?)<br><br>Construct validity – Are the instruments or research tools effectively assessing the content/theory we believe they are assessing? (For example, is an IQ test measuring all forms of intelligence?) | External validity – Is the study done in such a way that findings can be applied to the wider population? (For example, if one 18-year-old benefitted from a learning technique, will all 18-year-olds benefit?)<br><br>Criterion-related validity – Are the findings of the study consistent with that of other pieces of psychological research? (For example, the study suggests that personality does not change with age. Do other pieces of research agree?) |
| **Reliability** | Internal consistency reliability – Do all of the items in a test contribute equally to what they are measuring? (For example, if you completed all the odd-numbered questions, would you get the same score as if you completed all the even ones?)<br><br>Test–retest reliability – Does the test yield the same results when taken by the same person, in the same conditions, at another time? (For example, if they take the same IQ test twice, do they get the same score?)<br><br>Parallel forms reliability – Do two tests developed from the same content produce the same results? (For example, do two IQ tests with different questions produce the same score?) | Inter-rater reliability – Are the same results achieved when the same assessment tools are used by different administrators? (For example, if one researcher finds that someone is suffering from depression by using a scale, does another researcher find the same when using the same scale?) |


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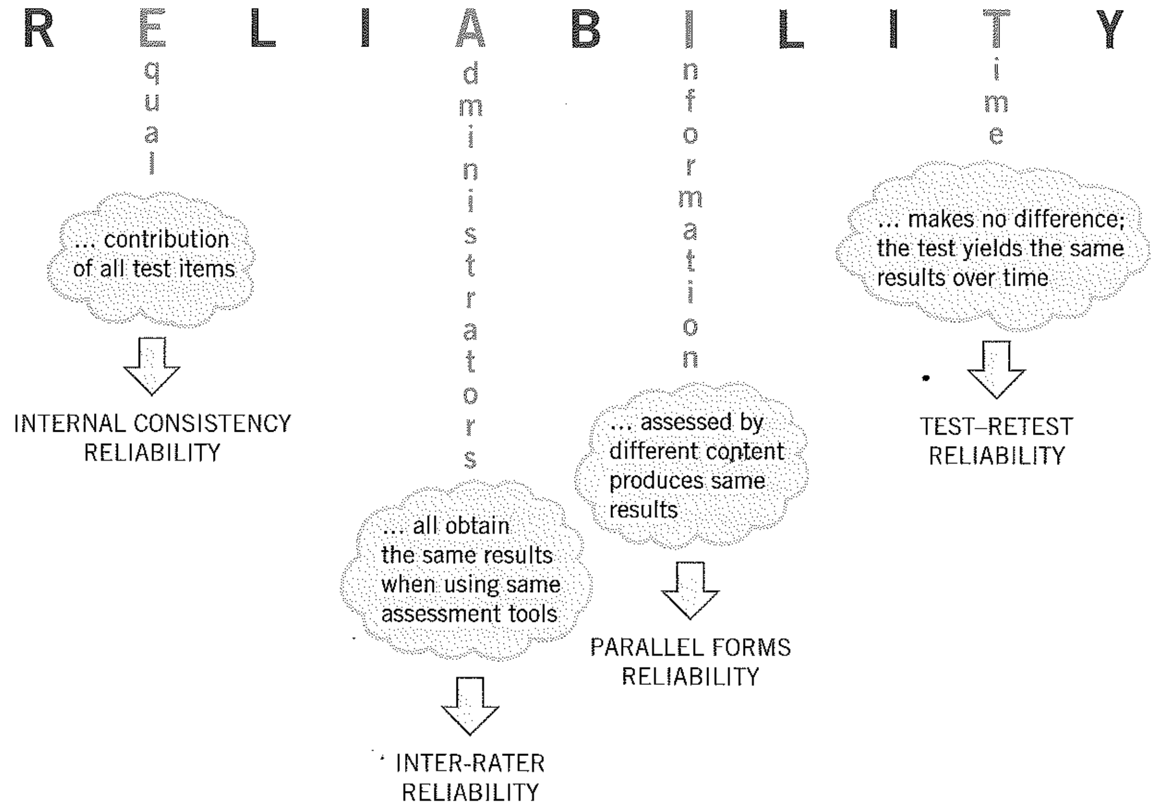
## Check your understanding

In the diagram below, the different types of reliability have been associated with specific letters from the word 'reliability'.




Try to construct a similar diagram with the word 'validity'. The diagram should demonstrate your understanding of the different types of validity, and can be used to help you remember and learn about the different types of validity.

V A L I D I T Y

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# 4.3 Conclusions and generalisations

As stated earlier, the main intention of research is to apply what has been learned to the population of interest. A conclusion is a decision or judgement about the research results. A conclusion addresses the hypothesis in research. If the results found are statistically significant, a researcher may conclude that the hypothesis is supported; if not, the hypothesis has been rejected. Before making a conclusion, you may also have to consider whether any extraneous variables may have impacted on the results. It is important that the researcher is confident that the change in the dependent variable is due to the independent variable.

If a conclusion has been made and the research meets certain other criteria (see below), the research findings can be applied to the broader population, or the wider group of research interest. When we apply research findings to the wider population, this is known as a generalisation.

A generalisation should only be made if all of the following criteria are met.

- The results are statistically significant.
- The sample is representative of the population.
- The method of sampling is appropriate.
- Wherever possible, extraneous and confounding variables have been controlled for.

For example, a researcher may find a statistically significant link between listening to music and enhancement of memory, but if the sample only contained 16-year-olds, the link cannot be generalised to other age groups. As another example, a teacher may have conducted research investigating the effect that the number of hours of study had on scores obtained in a maths test; however, if her sample only comprised students in her class, this sample is biased and not representative of the population. A final example might involve investigating the influence of mnemonic devices on the capacity of short-term memory. If Group A, which uses mnemonic devices, comprises only males, and Group B which does not use mnemonic devices, comprises only females, then gender is a possible confounding variable and the findings cannot be generalised.

Generalising results to the population is one of the main goals of psychological research. Experimenters do not often endeavour to discover something for only a small group of people; instead, they seek to discover something that can be applied to a large group of people, or an entire population.

'I didn't just jump to conclusions. I hopped and skipped first.'

**Figure 4.2** Jumping to conclusions, without appropriate experimental procedures, can create misleading findings.


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## Check your understanding

**1** Read the following articles. Discuss two reasons why it is difficult to generalise the results from these studies.

**a**

**The simple way to make people remember what you say**

Chip Heath is a professor at the Stanford Graduate School of Business. His students are among the best and brightest in the country.

During one of his classes, Heath asked his students to give a one-minute speech on a topic such as crime patterns in the USA. After each speech, the students in the audience rated each speaker. Not surprisingly, the most polished speakers usually received the highest ratings. The surprise happened 10 minutes after the last speaker. Heath asked the students to pull out a sheet of paper and write down every idea they could remember from each speaker.

The class was shocked to discover how little they recalled. For some speeches, students couldn't remember any ideas. In the average one-minute speech, speakers used 2.5 statistics. Only 1 in 10 told a story. But when it came time for recall, 63 per cent remembered the stories, compared to 5 per cent for statistics.

Source: Lem, P. (2009). The simple way to make people remember what you say. *Master Life Faster Newsletter*, 2(12). Retrieved from <masterlifefaster.wordpress.com/2009/12/22/why-coke-tastes-better-than-pepsi>.

**b**

**Does gingko biloba affect memory?**

The three-year study involved 118 people age 85 and older, with no memory problems. Half of the participants took ginkgo biloba extract three times a day and half took a placebo. During the study, 21 people developed mild memory problems, or questionable dementia: 14 of those took the placebo and seven took the ginkgo extract. Although there was a trend favouring ginkgo, the difference between those who took gingko versus the placebo was not statistically significant.

The researchers made an interesting observation when they examined the data at the end of the trial. Taking into account whether people followed directions in taking the study pills, they found that people who reliably took the supplement had a 68 per cent lower risk of developing mild memory problems than those who took the placebo. Without further study, it is unclear if this difference is real or just a chance occurrence.

Source: American Academy of Neurology (2008, March 1). Does Gingko Biloba Affect Memory?. *ScienceDaily*. Retrieved from <www.sciencedaily.com/releases/2008/02/080227164125.htm>.

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# 5 Ethics

## 5.1 Ethical considerations in psychological research

The term ethics refers to moral principles and codes of behaviour that apply to all psychologists, regardless of the field in which they work. The Australian Psychological Society (APS) has developed a *Code of Ethics* (2007) – as well as a complementary publication called *Ethical Guidelines* (2010) – that outlines the ethical guidelines that govern psychologists' behaviour. The *Ethical Guidelines* are regularly updated, and the most current guidelines can be viewed on the APS website: www.psychology.org.au.

Interestingly, over the years, ethical guidelines governing psychological research have become stricter, so that several psychological experiments conducted in the past would be considered unethical by today's standards.

Prior to the commencement of any research, the researcher submits a research plan to an ethics committee for approval. This ensures that participants' welfare is considered by a range of medical and non-medical professionals. The ethics committee also investigates potential benefits of the research to society, which need to be weighed against the potential risks or discomfort to participants.

### Role of the researcher

It is the researcher's responsibility in any research to protect participants' physical and psychological welfare. At no time must a researcher conduct a study that causes severe distress to participants. If a participant does encounter unexpected distress, the researcher must immediately stop the experiment and provide the participant with access to counselling. The experimenter must also ensure that they act professionally and with integrity at all times, being fair and just toward all participants.

### Participants' rights

As well as protecting the welfare of all participants, the researcher must respect the rights of the individual participant. To do this, the researcher should adhere to any relevant ethical guidelines, and to current National Health and Medical Research Council (NHMRC) guidelines. There are six main principles when considering a participant's rights.

Confidentiality is a participant's right to privacy in terms of access, storage and disposal of information collected about them that is related to research. A participant's involvement in and results from an experiment cannot be disclosed to anyone else unless written consent has been obtained.

Voluntary participation ensures that a participant willingly decides to take part in an experiment. Participants must not experience any pressure or coercion to participate, nor be threatened with any negative consequences if they decide not to participate in the experiment.

Withdrawal rights refers to the right of the participant to cease their participation in a study at any time without negative consequences or pressure to continue. This guideline must be adhered to during an experiment and also after an experiment; if a person feels uncomfortable during any follow-up activities they are involved in, or wishes to remove their results from being used in the study, withdrawal rights ensure that they can do this.

Informed consent needs to be obtained before an experiment commences. The researcher must obtain written, informed permission from each participant in the study, stating that they consent to participating in the study and have been informed of all necessary information. If a participant is under the age of 18, or is legally unable to give consent, the participant's parent or guardian should complete the consent form. The consent form must *inform* the participants about their rights, as well as any possible physical or psychological harm that may be encountered during the experiment. Where it is possible and reasonable, participants must be informed about the research procedures employed in the study.

Deception in research should not occur unless it is necessary. It is used in some cases where giving participants information about an experiment beforehand might influence their behaviour during the study and thus affect the accuracy of results. However, deception in research must be used with caution and, when it is used, researchers must ensure that all participants are thoroughly debriefed.

Debriefing is where participants are informed of the study's true purpose once the experiment has ended. During debriefing, a researcher must also correct any mistaken attitudes or beliefs held by the participants, and explain all deception related to the conducting of the experiment. The experimenter must also provide an opportunity for the participants to gain access to information about the study, including procedures, results and conclusions, and provide access to additional support through counselling, as required.


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## Check your understanding

A university lecturer has been asked to conduct research investigating how mild pain affects memory formation. She decides to use students from her tutorial class. She separates the students into two groups. She shows students in Group A a list of 20 words and then gives them two minutes to recall as many of the words as possible. She shows students in Group B the same list of 20 words, administers a mild electric shock to them, then gives them two minutes to recall as many of the words as possible.

**1** What are two major issues that an ethics committee may have with this research? Explain why they are areas of concern.

**2** Explain how you would address each of the following ethical guidelines if *you* were conducting this research.

**a** Voluntary participation

**b** Informed consent

**c** Deception

**d** Withdrawal rights

**e** Debriefing

**f** Confidentiality

**3** List some famous psychological experiments that have been conducted in the past that you would consider to be unethical by today's standards. Explain why you would consider then unethical.

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# 5.2 Non-humans in research

Ethical considerations do not just apply to humans; they also govern the use of animals in experimental research. Animal research can help us to gain insight into human patterns of behaviour. The use of animals in research has helped us to learn more about different concepts such as memory, learning, obesity, stress and ageing.

One of the most famous pieces of psychological research is that of Russian physiologist Ivan Pavlov, who in the late 1800s measured salivation levels in dogs to varying stimuli. American psychologist Harry Harlow is well known for his work with rhesus monkeys investigating attachment theory and insight learning in the 1950s and 60s. American William J. Hudspeth is also well known for research he conducted into memory consolidation in rats.

Similar to human research, the ethical considerations regarding treatment of animals in research have become stricter over the years, so that much of the early psychological experimentation conducted on animals is considered unethical today.

When using humans in experimental research, their ability to reason, judge and make assumptions about the aim of a study can cloud the results, as discussed earlier when examining the influence of the placebo effect and participant expectations. With this in mind, animals can be advantageous to study, as they can provide researchers with more natural and unbiased behaviour to be observed. Another advantage to using animals in research is that they have shorter life expectancies. This means that disease progression and the effects of ageing can be tracked quicker. They can also have shorter pregnancies, which allow researchers to look at genetic hereditary patterns across generations more rapidly.

However, although sometimes advantageous, the use of animals is not without limitations. One of the biggest limitations with using animals in psychological research is the difficulty in being able to generalise the findings to humans. Animals and humans vary in many ways, particularly in terms of their ability to use cognitive functions, so there are issues with external validity of results obtained in animal research. This makes it extremely difficult to apply findings from animal studies to the human population.

The use of animals in experimentation has for a long time been an emotionally-charged issue. Many concerns with animal experimentation revolve around the idea that the animal has 'no voice', and is therefore unable to give consent to be involved in experimentation; nor is an animal able to withdraw from a study. As animals cannot give consent or utilise withdrawal rights, it is therefore particularly important to avoid or minimise psychological and physical harm when using animals in experimental research. It is also important that animals are well cared for, even when not directly involved in experimentation (for example, when they are being housed in laboratories or testing facilities).

**Figure 5.1** Animals are often used in psychological research.


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## Check your understanding

**1** Using your knowledge of human and animal rights in psychological research, discuss the similarities and differences between the ethical standards that apply to both.

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**2** Complete the table to outline the advantages and disadvantages of using animals in experimental research.

| Advantages | Disadvantages |
|---|---|
| | |

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# 6 Reporting conventions

A research investigation (or research report) is a formal piece of writing that is written in a scientific manner. Therefore, you must make sure you avoid words such as 'I', 'we' or 'our class', and write in past tense.

## 6.1 Writing a research investigation: title, abstract, introduction

### Title

The title of your report should be a description of the variables that were manipulated and measured in the investigation. A good formula for working out the best title is to use the following phrase: 'The effect of [the IV] on [the DV]'.

### Abstract

The abstract is a very brief summary of all of the key elements of an investigation. Its purpose is to give other researchers an idea of what the study is about. An abstract typically features the *aim*, *hypothesis*, short descriptions of the *participants* used, the *results*, and a short summary of the *conclusion*. These pieces of information should be written without subheadings. Although the abstract appears first in the report, it is typically written last. It should be approximately 100–150 words in length.

### Introduction

The introduction is important since this is where you introduce your topic. Think of the opening of the introduction as a funnel, starting very wide (broad) at the top and then becoming very narrow (specific) at the bottom. Introduce your topic like an essay. What are the definitions for the key terms you are referring to? Is there background knowledge that needs explaining?

Once you have provided a funnel of background information, refer to past research in this field. What have others found before you? Remember to cite past publications correctly and include them in your reference list.

To finish the introduction, you will need to state the aim (a statement that explains what you are intending to investigate in an experiment), hypothesis(es) and the independent and dependent variables. The introduction should be approximately 200–600 words long.

Following is an example title, abstract and introduction.

**The effect of alcohol consumption on driving ability**

#### Abstract

In this study, the effect of alcohol consumption on driving ability was investigated. It was hypothesised that Melbourne University students who consumed two alcoholic drinks in one hour would have poorer driving abilities, operationalised as more errors on a driving simulator, than those who drank two non-alcoholic drinks in one hour. One hundred university students, comprising males and females, aged between 20 and 40 years, were randomly allocated to an experimental group (those who consumed two alcoholic drinks) and control group (those who consumed two non-alcoholic drinks). After consuming the drinks, they were tested on a driving simulator and the number of errors made was recorded. It was found that the control group made an average of five driving errors in the test, while the experimental group made an average of 13 errors. Results were found to be statistically significant and indicated that alcohol consumption impairs driving ability; thus, the hypothesis was supported.

#### Introduction

Alcohol use is linked to health problems and emotional and cognitive disturbances. There are strict laws in Australia that prevent people from driving a car while under the influence of alcohol. Previous research suggests there is a strong relationship between alcohol consumption and driving ability. Smith (1996) found that when participants consumed more than two alcoholic drinks in one hour (and fewer for some women) their driving ability was impaired. He found that participants who drank more than two alcoholic drinks in an hour were five times more likely to have a car accident and 15 times more likely to be at fault than people who had fewer than two alcoholic drinks in an hour. The aim of this study was to replicate Smith's findings by examining the effects of alcohol consumption on driving ability when using a simulator. It was hypothesised that Melbourne University students who consumed two alcoholic drinks in one hour would have poorer driving ability, operationalised as number of errors on a driving simulator, than those who had two non-alcoholic drinks in one hour. The independent variable was the number of alcoholic drinks consumed. The dependent variable was the number of driving errors made on a driving simulator.


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## Check your understanding

**1** Write a title for the following research experiments by using the format 'An investigation to test the effect of [the IV] on [the DV]'.

**a** A scientist wants to investigate how to increase serotonin levels to help combat depression. He decides to test a new serotonin medication on a random sample of university students, and compares the effects with students who have had no medication.

..........

..........

**b** An educational psychologist is trying to see whether or not confidence in public speaking can be increased using a variety of preparation techniques. She teaches one group of students how to write a good speech, and has another group take acting classes.

..........

..........

**2** Write the abstract for the scenario in question 1b by placing the following sentences in the correct order.

- The results showed that students who had learnt how to write speeches ranked themselves, on average, 8.2 out of 10 on a confidence scale, whereas those who had taken acting lessons rated themselves, on average, 8.7 out of 10 on a confidence scale.
- It was hypothesised that students who take acting classes will have greater confidence in public speaking, operationalised as a score on a confidence scale, than those students who learn how to write a good speech.
- In conclusion, it was found that learning acting skills is a better way to build confidence for public speaking than written preparation.
- There were forty 12-year-old students used in the investigation, of whom 24 were females and 16 were males.
- The aim of this investigation was to test the effect of different learning techniques on confidence in public speaking.

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..........

**3** Number each of the sections below in the order they appear in the introduction section of a research report.

☐ Independent and dependent variables

☐ Hypothesis

☐ Past research

☐ Theories and definitions

☐ Aim

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# 6.2 Writing a research investigation: method, results

## Method

The method is broken into three sub-sections and should be 150–200 words in total.

The first section is 'Participants'. In this section you should give the details of the sample, including how many participants were used in the study and their ages and genders. You might also like to mention the sampling method used.

Next is the 'Materials' section. In this section you must list every item that was required to conduct the study. You should also mention any question sheets or surveys you used, and ensure that you remember to attach these to the back of your report as an appendix (we will discuss the appendix in section 6.3, page 44).

The final section of the method is the 'Procedure'. This section is preferably completed using dot points and should be a step-by-step outline of how the experiment was conducted. Think of this section as though it were a recipe: if someone wanted to replicate your experiment they would simply pull out your procedure and follow the steps. This section should begin by explaining the participant selection process and end at the point when results were collated. Make sure you explain in the procedure what the control and experimental groups in the study did.

## Results

The results section should feature a visual representation of the data you have collated. Make sure the results represent collated/sorted data – that is, the descriptive statistics – and not raw data. Raw data comprise all of the individual participants' results, and are too long to be included in the results section. Attach the raw data to the back of your report as an appendix.

The results section may include graphs or tables, but you should only graph the average or the percentage, or whichever data presentation method you believe best illustrates your findings. Your visual representation must include a title and must be clearly labelled. Make sure that you label the *x*- and *y*-axes if you are using a graph.

Under your visual representation, explain your findings in words. There is no need to elaborate or explain your results in this section; simply state what the findings were.

You should also state the statistical significance of your results in this section. You may express this as an exact *p*-value (e.g. $p = 0.002$) or simply state whether the *p*-value of the results was above or below your set significance level. This section should be about 150–200 words.

Opposite is an example of how the method and results may look in a research investigation.

### Method

#### Participants

One hundred third-year university students were used in the study. Ages ranged from 20 to 40 years, with equal numbers of males and females.

#### Materials

The following materials were used to conduct the experiment:

- Alcohol
- Drinking glasses
- A driving simulator

#### Procedure

- Participants were selected from Melbourne University via random sampling and randomly allocated into either the experimental or the control group.
- In the experimental group, participants consumed two alcoholic drinks in an hour.
- In the control group, participants consumed two non-alcoholic drinks in an hour.
- After the two hours had elapsed, both groups of participants used the driving simulator.
- The number of errors was counted and used to measure the participants' driving skills.

### Results

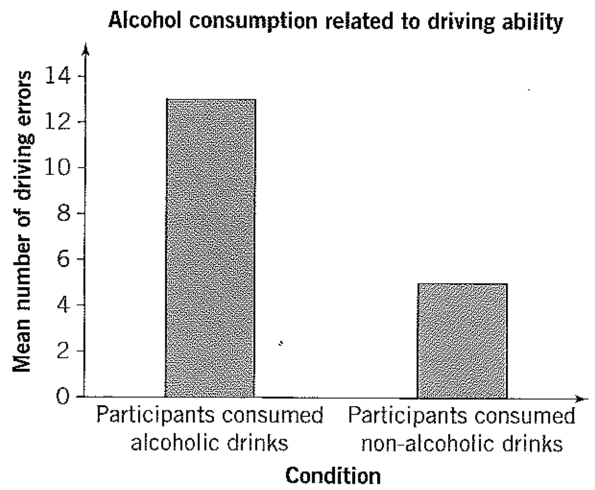


**Figure 1** The relationship between alcohol consumption and driving ability

The mean number of driving errors made by the control group was five. The mean number of driving errors made by the experimental group was 13 (Figure 1). The results were found to be significant at a $p < 0.05$ level. The results show that the experimental group made more driving errors on the simulator than did the control group. The raw data obtained can be found in Appendix 1.


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## Check your understanding

The method and results sections of the research investigation below include many mistakes. List all of the errors you can find with this research report and explain why they are incorrect.

### Method

#### Materials

In this experiment, I used a worksheet entitled 'How to write speeches' (attached in the References section). I also used a drama classroom, a lecture hall for public speaking and a confidence survey that the participants completed and handed in (individual participant responses are known as rare data and are attached to the references section).

#### Participants

In this experiment I used 20 participants in one group and 20 in the other.

#### Procedure

The participants were selected from a local primary school and two classes were chosen by convenience sample. One group of participants took a series of three drama classes. The others did not. All students then gave a speech in a lecture theatre and rated on a rating scale how confident they felt out of 10. These results were then collated. After this, a research report was written.

### Results

These results show all of the scores that the participants gave in terms of their rating of confidence.

The confidence ratings for participants who took the acting classes (out of 10):

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 9 | 7 | 8 | 9 | 7 | 6 | 3 | 9 | 10 |
| 8 | 9 | 8 | 7 | 5 | 10 | 9 | 9 | 8 | 9 |

The confidence ratings for participants (out of 10):

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 9 | 7 | 8 | 9 | 7 | 6 | 3 | 9 | 10 |
| 8 | 9 | 8 | 7 | 5 | 10 | 9 | 9 | 8 | 9 |

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# 6.3 Writing a research investigation: discussion, references, appendices

## Discussion

You should begin the discussion by restating your hypothesis and stating whether your results refute or support it. Make sure you provide sufficient evidence as to why your hypothesis is supported or rejected. You should then compare your findings to those in the past research that you discussed in the introduction, and explain any differences in the results, or anything in your results that you did not expect. Again, you must properly cite any publications you mention or paraphrase.

You must then discuss any extraneous variables and the effect they may have had on the results. Also, any suggestions for future improvements to the research should appear in this section.

Finally, you must provide a conclusive statement and discuss whether the results found in this study could be generalised to the population from which the sample was drawn. This may or may not be possible, based on a range of experimental conditions (as discussed in section 4.3). The discussion should be between 200 and 600 words long.

## References

Throughout your research investigation, you should cite any publications that you refer to, or that you paraphrase. The references, therefore, comprise a list of all publications you have cited in your research investigation. All references should be cited according to the American Psychological Association (APA) format. The format for books and journal articles is shown below, but there are APA conventions that should be followed for all types of publications.

For books, the format is:

Surname, I. (Year). *Title of book*. City of publication: Publisher.

For example:

Clayton, M. (2011). *The Brain and Behaviour*. Melbourne: Barkly Press.

For journal articles, the format is:

Surname, I. (Year). Title of the article. *Title of Journal, Volume of Journal* (edition number), page numbers.

For example:

Pickersgill, R. (2010). Speed of neurons. *Psychology Investigator*, *8*(2), pp. 32–36.

## Appendices

An appendix (plural: appendices) is something that is supplementary to the main body of your report, and should appear at the end of the report. The appendices section includes all the individual appendices relevant to your report. Appendices would include such things as the raw data from the results, as well as any sheets, questions or surveys used in your investigation. Make sure your appendices are numbered and are referred to where appropriate in the body of the report.

Below is an example of how the 'Discussion' and 'References' sections should be presented.

### Discussion

It was hypothesised that Melbourne University students who consumed two alcoholic drinks in one hour would have poorer driving ability, operationalised as errors on a driving simulator, than those students who consumed two non-alcoholic drinks. The hypothesis was supported, in that the results suggest that participants who consumed alcohol made more errors on the driving simulator than the participants who did not consume alcohol.

The findings also support previous research by Smith (1996) that alcohol consumption is likely to cause impairment in driving ability.

Extraneous variables that could have affected the results include individual differences in tolerance to alcohol. Some individuals can drink more than others and retain their driving ability. Factors such as mood, weight, body fat content and whether a person has just eaten all effect how much an individual could be affected by alcohol. One way of overcoming these individual differences is to employ a repeated-measures design. Instead of having two independent groups of participants (the experimental and the control group), the same subjects could be used in the experimental and control groups.

Another extraneous variable may be that of artificiality, as participants were using a driving simulator and hence the situation was not real. They were also aware that they were being watched as they used the simulator, which may have resulted in participants being more careful than they usually would when driving, or they may have felt nervous. This may have lead to an increase or decrease in the number of driving errors due to the simulated environment. One way to overcome this variable is to conduct more trials and have the experimenter outside of the room. After conducting more driving trials the participant may become more relaxed and familiar with the artificial environment, and hence behave in a naturalistic way.

It can be seen that consumption of alcohol increased the number of driving errors, and it can be concluded that consumption of alcohol has a negative effect on driving ability. As the results are statistically significant, they can be generalised to the Melbourne University student population.

### References

Smith, J. (1996). The effect of alcohol consumption on driving ability in doctors. *Journal of Traffic Accidents, 12*, pp. 44–56.



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## Check your understanding

**1** Read again the description of the experiment in Check your understanding section 6.1, question 1b (page 41), which involved preparation techniques and their effect on confidence with public speaking. Discuss two extraneous variables in that experiment, and how they could be avoided in future.

Extraneous variable:

Future improvements:

Extraneous variable:

Future improvements:

**2** Reference the two books below using APA format. Use underlining to represent italics.

**a** Brain Surgery for Beginners, written by Jean Geoffs. Published by Ebony House in Melbourne in 2005.

**b** Measuring your Emotional Intelligence, published by Construction Place in Canberra. Written in 2007 by Thomas Peters.

**3** Think again about the study into the effect of preparation techniques on confidence in public speaking (page 41). Describe all of the resources that may have appeared in the appendices of the research investigation written about that study.

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# 6.4 Write your own research investigation

Popular theory about memory states that is it separated into three subsystems: sensory memory, short-term memory and long-term memory. It is the process of encoding information from short-term to long-term memory that is of particular interest to psychologists and educators alike. Once a memory is consolidated in long-term memory, it is relatively permanent. This means that once you transfer material learned in school to your long-term memory, it will stay there indefinitely.

There are always new theories and ideas emerging as to the best ways to enhance memory. It is widely known, for example, that memory aids such as mnemonic devices can help to enhance memory. Additionally, many students claim that listening to music helps them to retain information; others say that writing out definitions over and over again helps them to retain information.

The following article includes some interesting findings regarding memory enhancement.

## Chewing gum improves memory

Chewing gum can improve memory, say UK psychologists. They found that people who chewed throughout tests of both long-term and short-term memory produced significantly better scores than people who did not. But gum-chewing did not boost memory-linked reaction times, used as a measure of attention.

'These results provide the first evidence that chewing gum can improve long-term and working memory,' says Andrew Scholey of the University of Northumbria in Newcastle, UK. 'There are a number of potential explanations – but they are all very speculative.'

One-third of the 75 adults tested chewed gum during the 20-minute battery of memory and attention tests. One-third mimicked chewing movements, and the remainder did not chew at all.

The gum-chewers' scores were 24 per cent higher than the controls' on tests of immediate word recall, and 36 per cent higher on tests of delayed word recall. They were also more accurate on tests of spatial working memory.

'The findings are intriguing, although it is clear that questions remain to be addressed,' says Kim Graham of the Medical Research Council's Cognition and Brain Sciences Unit in Cambridge, UK. 'In particular: what is the mechanism by which chewing improves memory?'

**Chewing it over**

There are three main potential explanations, says Scholey. In March 2000, Japanese researchers showed that brain activity in the hippocampus, an area important for memory, increases while people chew – but it is not clear why.

Recent research has also found that insulin receptors in the hippocampus may be involved in memory. 'Insulin mops up glucose in the bloodstream and chewing causes the release of insulin, because the body is expecting food. If insulin receptors in the brain are involved in memory, we may have an insulin-mediated mechanism explaining our findings – but that is very, very speculative,' Scholey says.

But there could be a simpler answer. 'One interesting thing we saw in our study was that chewing increased heart rate. Anything that improves delivery of things like oxygen in the brain, such as an increased heart rate, is a potential cognitive enhancer to some degree,' he says.

Source: Young, E. (2002, 13 March). Chewing gum improves memory. *NewScientist*. UK: Reed Business Information Ltd.


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## Check your understanding

The article opposite gives evidence to support quite a widespread myth: that chewing increases memory. You will now conduct an investigation that aims to see whether this is the case within a population of your choosing.

For this experiment you will need:

- participants
- a list of 15–20 words (they could be nonsense words or three-letter words)
- something for participants to chew.

Conduct an experiment in which participants learn and then attempt to recall the list of words. Half of your participants are to chew as they do so; the other half are not to chew.

You are the experimenter and the rest of the details are up to you. How many people will you use? Will there be a time limit for recall? Will they chew while they originally look at the words, or only when they attempt to recall the words? Will they chew lollies, gum or something else?

Follow the steps below to prepare for your experiment and gather your data. You will then write your own research investigation in the space provided.

**1** Start by writing down what it is you are aiming to find.

**a** The aim of this experiment is to:

..........................................................................................

..........................................................................................

**b** The independent variable is:

..........................................................................................

**c** The dependent variable is:

..........................................................................................

**2** Now that you know what you are investigating, you will need to formulate a hypothesis.
It is hypothesised that:

..........................................................................................

..........................................................................................

..........................................................................................

**3** You now need to design a method. Try answering the following questions to help you finalise the details of your method.

**a** How many people will you test?

..........................................................................................

**b** Where will you gather these participants from? How?

..........................................................................................

..........................................................................................

**c** List all the materials you will need to conduct the experiment. When you have listed them, gather them in preparation for using them in step 7.

..........................................................................................

..........................................................................................

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4 Try writing up your step-by-step procedure.

5 Before you conduct your experiment, you must consider all ethical guidelines and principles. State how you will adhere to each of these ethical considerations.

Confidentiality:

Voluntary participation:

Informed consent:

Withdrawal rights:

Deception:

Debriefing:

6 You also need to consider all elements that may become extraneous variables. It is important to eliminate as many of these as possible, to help obtain reliable results. List some of the things you will do to try to eliminate extraneous variables, or list possible extraneous variables that may occur.

7 Now you are ready to conduct your experiment and collect your data.

a Record the details of your participants in the space below. Include number, age and gender of participants.


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b Collect your data and fill in the table with your raw data.

| | Group A: Chewing | Group B: Not chewing |
|---|---|---|
| **Number of words recalled** | | |

8 It is now time to use descriptive statistics to organise your data. You could use percentages, means, medians or modes; however, a mean is probably the best measure for this study.

| | Group A: Chewing | Group B: Not chewing |
|---|---|---|
| **Number of words recalled** | | |

9 The *p*-value for statistical significance set for this experiment is $p < 0.05$. You now need to work out the *p*-value of your results to see if they are statistically significant, according to the set *p*-value. You will need a graphics calculator to calculate the *p*-value of your results. Under the statistics menu of most graphics calculators there is an option to run a sample *t*-test. When you find this, enter your raw data into the table on the calculator to find the *p*-value of the data. Record the *p*-value of your results below. Are your results statistically significant in terms of the set *p*-value?

10 Has your hypothesis been accepted or rejected? Was this what the past research (the article) suggested?

11 It is now time to prepare to write your research investigation. Check that you have all the necessary materials before you start writing.

**Research investigation checklist**

| | |
|---|---|
| Number, ages and genders of participants | |
| List of all materials used | |
| Raw data for appendices | |
| Past research | |
| All referencing details | |

If you have checked off all the items in the checklist, you are ready to go. Time to start writing!

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# Glossary

**Abstract**
A section of a research investigation that appears first and is a very brief summary of all of the key elements of the investigation

**Aim**
A statement that explains what you are intending to investigate in an experiment or research study

**Appendix (plural: appendices)**
A section of a research investigation that includes any raw data used in an experiment, as well as additional materials such as questionnaires

**Artificiality**
An extraneous variable whereby the unnatural environment in which an experiment is conducted impacts on participants' behaviour

**Bar graph**
A graph of discrete data; its bars do not touch

**Bi-modal distribution**
A frequency distribution curve that shows two midpoints in a data set

**Brain imaging and recording**
A data-collection technique that involves gaining structural or functional images of an active brain

**Case study**
A data-collection technique involving an in-depth or detailed study on a singular person or small group of people

**Causal**
To imply that one variable created a change in another; there is a cause-and-effect relationship

**Chi-square test**
An inferential statistic that allows researchers to determine the statistical significance of a set of results

**Class interval**
A category or group of data, used when sorting raw data into descriptive statistics

**Conclusion**
A decision or judgement about the meaningfulness of the results of a research investigation

**Confidentiality**
An ethical consideration that describes a participant's right to privacy in terms of access, storage and disposal of information about them related to a research study

**Confounding effect**
The effect of a confounding variable in an experiment; when a confounding variable alters the results of an experiment

**Confounding variable**
A variable other than the independent variable that causes a change in the dependent variable, and therefore its effects may be confused with those of the independent variable in a study

**Construct validity**
Whether or not the instruments or research tools used in a study effectively assess the content/theory that they are supposed to assess

**Content validity**
Whether or not the instruments or research tools used in a study assess what they are supposed to assess

**Control group**
The group in an experiment that is exposed to the control condition; where the variable under investigation is absent

**Convenience sampling**
A sampling technique used in selecting participants for a study, which involves selection of participants based on easy accessibility and availability

**Correlation**
The relationship between two things; in Psychology, the relationship between two variables

**Correlation co-efficient**
The number that describes the strength and direction of the correlation

**Counterbalancing**
A technique used in a repeated-measures experimental design, which involves arranging the order of the conditions so that each condition occurs equally as often in each position

**Criterion-related validity**
Whether or not the findings of a study are consistent with those of other pieces of psychological research

**Cross-sectional study**
When a researcher seeks to investigate two or more samples of participants at the same point in time

**Data**
Information (observable facts) that psychologists systematically collect in studies, investigations and experiments

**Debriefing**
An ethical consideration whereby participants are informed of a study's true purpose and findings once the experiment has ended, and information is given about counselling services if necessary

**Deception**
An ethical consideration where participants are not fully informed about the procedures or aims of the experiment before it is conducted because knowing the purpose might influence their behaviour; they must be thoroughly debriefed afterwards

**Demand characteristics**
Extraneous variables that arise when a participant changes their behaviour during a study so that their behaviour is not natural

**Dependent variable (DV)**
The variable that is observed or measured in an experiment; that which is affected by the experimental condition and is used to measure the effect of the independent variable

**Descriptive statistics**
Statistics used to summarise, organise and describe data obtained from research

**Discussion**
A section of a research investigation where the significance of the findings are discussed

**Double-blind procedure**
An experimental procedure where the participants and experimenter do not know who has been assigned to the control and experimental groups

**Empirical evidence**
Information that psychologists gain from direct observation and measurement

**Ethics**
The moral principles and codes of behaviour that psychologists must abide by

**Ethics committee**
A group, comprised of a range of medical and non-medical professionals, that ensures that the welfare of participants involved in a study is considered

**Experiment**
A study under controlled conditions that investigates a cause-and-effect relationship between two or more variables and tests a hypothesis; investigates whether a change in one thing has an impact on another

**Experimental group**
The group (or groups) in an experiment that is exposed to the experimental conditions; where the variable being manipulated (independent variable) is present

**Experimenter effect**
An extraneous variable caused when there is an unintentional change in participant's behaviour, and hence results, due to the experimenter's influence

**External validity**
Whether or not a study is done, and reported, in such a way that findings can be applied to the wider population

**Extraneous variable (EV)**
Any variable other than the independent variable that may cause a change in the results of, and therefore may have an unwanted effect on, an experiment

**Frequency distribution curve**
A graph that shows the spread of a set of scores in a set of data, over equally-sized intervals

**Frequency distribution table**
A table used to sort raw data; the categories being compared are placed in one column and the frequency with which they occur are placed in the other column

**Frequency polygon**
A line graph of a frequency distribution in which the number of scores falling in each class interval is plotted as a point; lines are drawn to connect the points

**Generalisation**
When the findings of one experiment are applied to the population of interest for the research

**Graph**
A visual display of data that enables large amounts of information to be neatly organised and summarised, and shows the relationship between two variables

**Histogram**
A bar graph of continuous data; its bars are always touching

**Hypothesis**
A testable prediction about the relationship between two or more variables

**Independent-groups design**
An experimental design that involves randomly allocating members of the sample to either the control or experimental groups

**Independent variable (IV)**
The condition that an experimenter systematically manipulates, changes or varies in order to gauge its effect on another variable (the dependent variable)

**Inferential statistics**
Mathematical calculations or sets of data used to make inferences, form conclusions and to generalise findings about results obtained from research

**Informed consent**
An ethical consideration whereby a researcher must obtain written permission from each participant involved in a study, stating that they consent to participating in the study and have been informed of all necessary information, including their rights

**Internal consistency reliability**
Whether or not all of the items in a test contribute equally to what it is measuring

**Inter-rater reliability**
Whether or not the same results are achieved in a test when the same assessment tools are used by different administrators

**Interview**
A type of self-report, which involves face-to-face or telephone contact in which questions are asked and answered

**Introduction**
The section in a research investigation where the background of a topic is introduced

**Line graph**
Any single line that connects points that relate one variable to another

**Longitudinal study**
An investigation into a person or group of people over a period of time, where data is taken at intervals

**Matched-participants design**
An experimental design that involves pairing each participant based on a certain characteristic that they share, and then allocating one to the control group and one to the experimental group

**Mean**
A measure of central tendency; the number found when all of the scores in a data set are added together and then divided by the total number of pieces of data

**Measures of central tendency**
Calculations that shows how typical scores, or a majority of scores, fall in a data set

**Median**
A measure of central tendency; the middle number in a data set


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**Method**
A section in a research investigation where the details of participants, materials and the procedure are stated

**Mode**
A measure of central tendency; the most commonly occurring number in a data set

**Negative correlation**
A relationship between two variables where, as one variable increases, the other variable decreases, or, as one variable decreases, the other variable increases

**Negatively skewed distribution**
A frequency distribution that shows more high scores than low scores

**Objective data**
Data collected under controlled conditions

**Observational study**
A data-collection technique that involves an individual watching a group of people in a natural environment and recording observations about their behaviour

**Observer bias**
Where an observer in a research study sees what they want or expect to see; it may result in a biased representation of the displayed behaviour

**Operational hypothesis**
A testable prediction that explains how variables in an experiment will be measured and manipulated as well as states the population from which the sample is drawn

**Operationalise**
To state what each variable in an experiment is, and how it will be measured

**Order effect**
An extraneous variable that occurs in a repeated-measures design and is a change in results due to the sequence in which two tasks are completed

**Participants**
The people or animals used in a scientific study

**Parallel forms reliability**
Whether or not two tests developed from the same content produce the same results

**Percentage**
A mathematical calculation that demonstrates the proportion of a sample that reflects a particular behaviour

**Pie chart**
A graph that shows the representative characteristics or opinions of subsets of the sample as a proportion of the entire sample

**Population**
The entire group of people belonging to a particular category that is of research interest

**Placebo**
A fake drug or treatment that is used in an experiment so that neither group knows who is being exposed to the experimental condition

**Placebo effect**
A change in a participant's behaviour due to their expectations regarding the treatment they are receiving

**Positive correlation**
A relationship between two variables where, as one variable increases, the other variable increases, or, as one variable decreases, the other variable decreases

**Positively skewed distribution**
A frequency distribution that shows more low scores than high scores

**p-value**
The level of probability that the results of a study are due to chance alone

**Qualitative data**
Data that describes changes in the quality of behaviour and is often expressed in words

**Quantitative data**
Data collected through systematic and controlled procedures that is usually presented in numerical or categorical form

**Questionnaire**
A data-collection technique where participants respond to a series of written questions

**Random allocation**
A participant allocation technique that ensures that every member of the sample has an equal chance of being assigned to either the control group or the experimental group in an experiment

**Random sampling**
A sampling technique used in selecting participants for a study, which ensures every member of a population has an equal chance of being selected for the sample being used in the study

**Random stratified sampling**
A sampling technique used in selecting participants for a study, which involves breaking the population into strata, or groups, and then selecting the sample from each strata at random in the same proportions they appear in the population

**Range**
A measure of variability that is calculated by subtracting the lowest score in a data set from the highest score

**Rating scale**
A type of self-report that requires individuals to choose a statement that best describes their opinion or attitude on a particular topic

**Raw data**
The actual data collected from undertaking research; all of the individual participants' results in an experiment/study/research investigation

**References**
The section of a research investigation that details any materials or publications cited within the research investigation

**Reliability**
The extent to which an assessment tool measures what it is supposed to measure consistently, each time it is used

**Repeated-measures design**
An experimental design that uses only one group of participants and exposes that group to both the control and experimental conditions

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**Research hypothesis**

A general prediction about the direction or interaction between the independent variable and the dependent variable and the population from which the sample is drawn

**Results**

A section of a research investigation that features a visual representation of the data that has been collated, as well as a brief written description of the data

**Sample**

A group of participants selected from, and representative of, a population of research interest

**Sample statistics**

Numbers that describe the behaviour or characteristics of a sample drawn from a larger population

**Scatterplot**

A graph in which each piece of data, as it is measured against two axes in a correlation study, is represented by a dot

**Self-report**

A data-collection technique where individuals comment on their own thoughts, emotions and beliefs

**Single-blind procedure**

An experimental procedure in which the participants do not know whether they have been assigned to the control or experimental group

**Skew**

To move in a particular direction; when there is a large amount of data at one end of a spread of scores

**Standard deviation**

A measure of variability that describes how each individual piece of data differs from the mean

**Standardise**

When a psychological test and all its associated procedures and conditions are the same each time the test is administered

**Stratified sampling**

A sampling technique used in selecting participants for a study, which involves breaking the population into strata, or groups, based on characteristics they share, and selecting participants from each strata in the same proportions that they appear in the population

**Statistical significance**

A measure used to determine the likelihood that a set of results occurred due to chance

**Subjective data**

Data collected through observations of behaviour or participants' self-reports

**Survey**

A data-collection method whereby participants respond to a series of questions, either verbally or through written communication

**Test–retest reliability**

Whether or not a test yields the same results when taken by the same person, in the same conditions, at different times

**Title**

A description of the variables that are being manipulated and measured in a graph or research investigation

***t*-test**

An inferential statistic that allows researchers to determine the statistical significance for a set of results

**Validity**

The extent to which an assessment tool actually measures what it is designed to measure

**Variability**

A mathematical calculation that describes how a set of scores in a data set is spread

**Variable**

Any condition that can change

**Voluntary participation**

An ethical consideration that ensures that a participant is willing to participate in, or be part of, an experiment

**Withdrawal rights**

An ethical consideration that refers to the right of a participant to leave a study at any time without pressure or negative consequences



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# Answers

## 1.1

*Sample answers:*

Step 2: It is hypothesised that adolescent males who listen to music while studying will score higher on a test of retention of the material studied than adolescent males who do not listen to music while studying.

Step 3: Participants will be separated into two groups – one group will study while listening to music; one group will study without music. Participants will be tested on the material studied.

Step 4: Data will be collected by marking participants' tests on the material studied.

Step 5: The raw data show that test results are higher for participants who listened to music while studying when compared to results of participants that did not listen to music while studying.

Step 6: The findings suggest that, in adolescent males, listening to music while studying enhances retention of material being studied.

## 1.2

**1 a i** Whether food is given before or after completing the maze

**ii** The time it takes the rats in each group to find the cheese/complete the maze

**b i** The flavour of muffin made (either blueberry or chocolate)

**ii** The number of compliments received

**c i** The language-learning technique used (hearing or reading)

**ii** Participants' scores on a language test

**2** *Sample answers:*

**a** Select a sample of child participants who do not have any known degenerative eye disease. Test their visual functioning. Split the sample into two equal groups. Have each group watch TV for one hour per day for one month, but have one group watch TV from a distance of 1 metre and have the other group watch TV from a distance of 3 metres. Retest each participants' visual functioning. Compare the test results.
Operationalised IV: The distance from which the TV is watched (1 metre or 3 metres)
Operationalised DV: The difference in visual functioning between the first and second tests

**b** Select a sample of child participants and cut a strand of hair from the top of each of their heads, as close to the scalp as possible. Take two measurements: the length of the hair when pulled straight, and the length of the hair when left to fall naturally. Work out the difference between these two measurements for each participant. Split the sample into two equal groups. Have participants in each group eat two pieces of plain bread each day for one month, but have one group eat the bread in its entirety, including crusts, and one group eat the non-crust parts of the bread only. After the month, cut another strand of hair from the same area on the top of each child's head and repeat the measurements, again finding the difference between lengths when the hair is pulled straight and let to naturally fall. Compare the difference in lengths prior to the test with the difference in lengths after the test.
Operationalised IV: Whether or not crusts were eaten
Operationalised DV: Difference in maximum hair length and naturally-falling hair length between original and final tests

## 1.3

**1** IV: Undertaking (or not) meditation before going to bed
DV: Participants' average sleep ratings
Research hypothesis: It is hypothesised that 40-year-old males who meditate will have better quality sleep than those who do not meditate.
Operational hypothesis: It is hypothesised that 40-year-old males who meditate for 10 minutes before going to bed will have better quality sleep than those who do not meditate before bed, as measured by higher average scores on a self-report sleep rating scale.

**2** IV: The way the class notes are presented
DV: The difference in student examination scores between mid-year and end-of-year exams
Operational hypothesis: It is hypothesised that when Year 12 students are taught using written notes on the board they will have a poorer understanding of the subject than when taught using PowerPoint presentations that include visual cues, as measured by scores in the end-of-year examination compared with scores in the mid-year examination.

**3** IV: The age of participants
DV: Participants' average scores on memory tests
Operational hypothesis: It is hypothesised that Victorians aged 20–30 will have better memories than Victorians aged 50–60, as measured by comparison of average scores on a series of memory-related tests.

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## 1.4

1 Population: The entire group of people belonging to a particular category that is of research interest
Sample: A group of participants selected from, and representative of, a population of research interest
Random allocation: An allocation technique that ensures that every member of the sample has an equal chance of being assigned to either the control group or the experimental group in an experiment
Control group: The group exposed to the control condition; that is, where the variable under investigation (IV) is absent
Experimental group: The group (or groups) exposed to the experimental condition(s); that is, where the variable being manipulated (IV) is present

2 The control group is used as a basis of comparison to see if the experimental condition has caused a change in the DV. Without the experimental group, the researcher would not know if there has been a change, nor what has caused it.

3 *Sample answers:*
Control group: Eat burgers in the takeaway franchise with no music present
Experimental group 1: Listen to pop music while eating burgers in the takeaway franchise
Experimental group 2: Listen to classical music while eating burgers in the takeaway franchise
Experimental group 3: Listen to heavy metal while eating burgers in the takeaway franchise

## 2.1

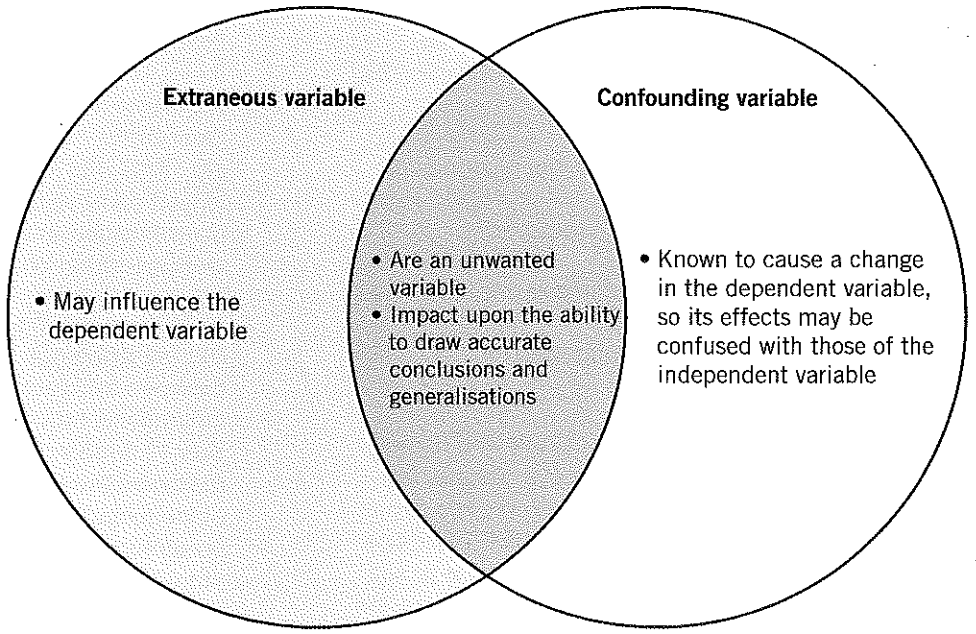
1 *Sample answers:*

a EV due to participant differences: Participants' existing skills may have differed across the groups – that is, participants in the Friday-night group may have been better tennis players than those in the Saturday-night group, or vice versa.
EV due to non-standardised procedure: It may have been windier on one night than the other, thus influencing serving accuracy.

b EV due to participant differences: There may not be an equal number of males and females in each group, and gender can affect the body's ability to process alcohol.
EV due to artificiality: There may be fewer driving errors due to participants concentrating because they are being watched, or participants may modify their driving behaviour due to using a simulator.

c EV due to participant differences: The mood in each of Ms Luk-Tung's classrooms may differ due to time of day, weather etc., and this mood may affect the way in which students respond to the survey.
EV due to demand characteristics: As the students will not be anonymous, students may give positive feedback regardless of their true feelings, for fear of getting in trouble.

2





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## 2.2

1

| | |
|---|---|
| Double-blind procedure | An unintentional change in participants' behaviour, and hence results, due to the experimenter's influence |
| Experimenter effect | A fake/false drug or treatment |
| Single-blind procedure | The participants and experimenter are unaware of who is in the control and experimental groups |
| Placebo effect | The participants are unaware of who is in the control and experimental groups |
| Placebo | A change in a participant's behaviour due to their expectations of being involved in an experiment |

2

| | Similarities | Differences |
|---|---|---|
| Placebo and placebo effect | They are both concerned with the influence of participant expectations in research. | The placebo eliminates the impact of the placebo effect on results. |
| Single-blind procedure and double-blind procedure | In both procedures, participants are unaware whether they are in the control or experimental group.<br>They both help to reduce extraneous variables in a study (such as the placebo effect). | In a single-blind procedure the experimenter is aware of which participants are in the control and experimental groups; in a double-blind procedure they are not aware. |

## 2.3

1 *Sample answers:*
- Ask your friends and family.
- Ask people at the local shopping centre.
- Ask your classmates.

2 *Sample answers:*
- Gather the names of everyone in Year 12, place them in a hat or box, and draw out 20 at random.
- Enter the students' ID numbers into a database and sort the database at random, then choose the first 20.
- Have each person in Year 12 stand in a long line and select every nth person.

3 *Sample answer:* She may split the workplace into four strata: women under 40, women over 40, men under 40 and men over 40. She could then take a sample from each of these groups in the same proportions that they appear in the company.

4

| | Convenience sampling | Random sampling | Stratified/Random stratified sampling |
|---|---|---|---|
| How are participants sampled? | Participants are selected for the sample based on the ease of access and selection. | Participants are selected using a random method so that every member of the population has an equal chance of being selected for the sample. | Members of the population are broken into strata based on particular characteristics.<br>Stratified: A proportionate number of members in each group are selected for the sample.<br>Random stratified: A proportionate number of members in each group are randomly selected for the sample. |

*(continued)*

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| | Convenience sampling | Random sampling | Stratified/Random stratified sampling |
|---|---|---|---|
| Advantages of this method | The sample is very easy to obtain. | It is time- and cost-efficient to select a large sample. | The sample is representative of the population. |
| Disadvantages of this method | The sample is likely to be biased. | The sample may not actually be representative of the population. | It takes a lot of resources (time and money) to select a sample. |

## 2.4

1

| | Explanation | Advantage(s) | Disadvantage(s) |
|---|---|---|---|
| Independent-groups design | Every member of the population has an equal chance of being selected for either the experimental or control group. | Inexpensive, quick and easy to run<br>Can sample large numbers of participants<br>No pre-testing or order effects | May not be a representative sample of the population as no differences between groups have been controlled; i.e. one group may be naturally more intelligent etc. |
| Matched-participants design | After pre-testing, those with similar characteristics are paired together and one is assigned to the experimental group and the other to the control group. | Many extraneous variables due to participant characteristics are eliminated, as both groups are paired on certain characteristics. | Time-consuming and costly, as a pre-test must be conducted to match the participants<br>If one participant is lost from the study, the matching pair must be removed. |
| Repeated-measures design | The same group of participants is subjected to both the control and experimental conditions. | Extraneous variables related to participant characteristics are eliminated, as the same group of participants is used.<br>Smaller samples can be used. | Order effects can impact on the results. |

**2 a** Repeated-measures design; all participants are exposed to both the control and experimental conditions

**b** *Sample answers:*
- Interference from the first word list when learning the second word list
- Boredom in learning the second word list due to repetition of the task
- Improved ability in learning second word list due to practice

**c** You could expose half of the participants to the control condition (no energy drink) then the experimental condition (energy drink), and the other half to the experimental condition then the control condition.

## 3.1

*Parts b and c of the answers below are sample answers.*

**1 a** Self-report
**b** Can provide personal insight and explanation
**c** Can be restrictive and difficult to compare data

**2 a** Observational study
**b** Eliminates the extraneous variable of artificiality (free from participant influence)
**c** Subject to observer bias; there are no explanations behind the behaviour

**3 a** Brain imaging and recording technology
**b** Can reveal highly specific and accurate information about brain structure and function
**c** Difficult to generalise findings to the wider population

**4 a** Case study
**b** Allows great insight and very specified information about rare phenomena
**c** Difficult to generalise findings to the wider population, especially in the case of brain damage


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## 3.2

1

| Types of data | Objective/Subjective | Qualitative/Quantitative |
|---|---|---|
| Hair colour | Objective | Quantitative |
| Number of hours spent watching TV per day | Objective | Quantitative |
| What people see in an inkblot test | Subjective | Qualitative |
| Descriptions of why students like doing homework | Subjective | Qualitative |
| Average height of students in a Year 10 class | Objective | Quantitative |

**2** *Sample answers:*

**a** Verbally ask a sample of students their opinions on why they are 'for' or 'against' wearing a school uniform; have students fill in a survey of open-ended questions about the school uniform

**b** It is difficult to summarise and collate the data so that they can be described and/or compared to other data.

**c** Ask students to simply state whether they are 'for' or 'against' wearing a school uniform – do not ask them for reasons.

**d** It is still based on students' opinions and therefore cannot be observed or measured accurately.

**e** Over a period of time, she could count the number of students who wear the uniform and the number of students do not wear the uniform, to objectively assess student preferences.

## 3.3

**1 a** 7.4
**b** 6.5
**c** 7
**d** The median, as it removes the influence that the top scorer and bottom scorer have on the results and gives a better picture of an average player on the team.
**e** 28 per cent
**f** No, descriptive statistics do not allow conclusions to be drawn.

**2 a** 23
**b** 7
**c** Sarah's class has high variability, whereas Maeve's class has low variability.
**d** No, descriptive statistics do not allow conclusions to be drawn.

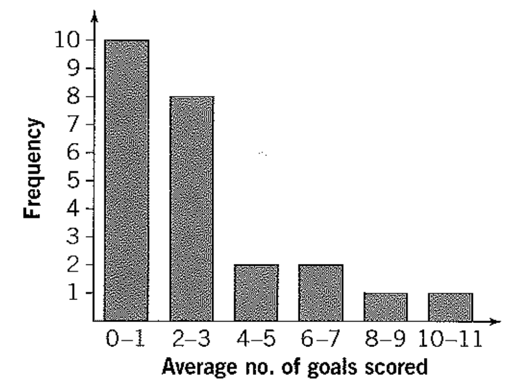
## 3.4

**1 a**

| Class interval (Average no. of goals) | Frequency |
|---|---|
| 0–1 | 10 |
| 2–3 | 8 |
| 4–5 | 2 |
| 6–7 | 2 |
| 8–9 | 1 |
| 10–11 | 1 |

**b** The data is discrete because a player cannot score a number of goals that is not a whole number and the scores are not on a continuum.

**c**

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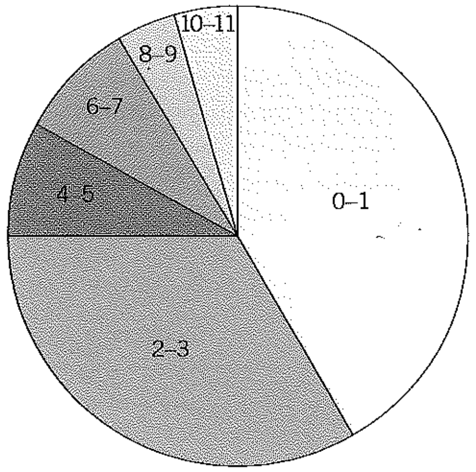
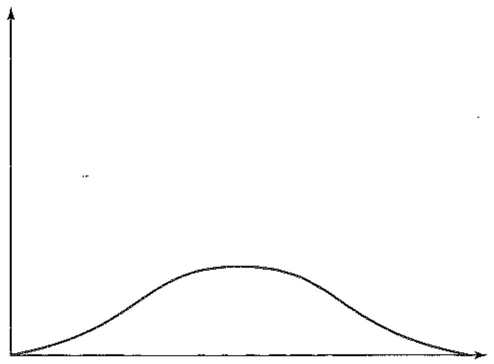
d

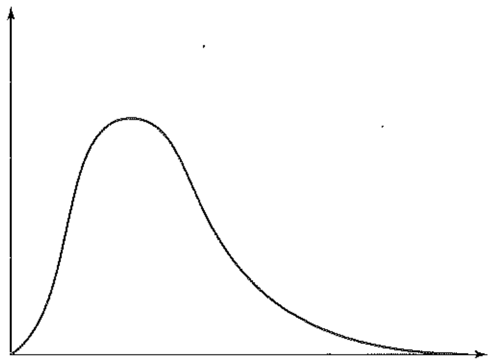



## 3.5

1 a



b



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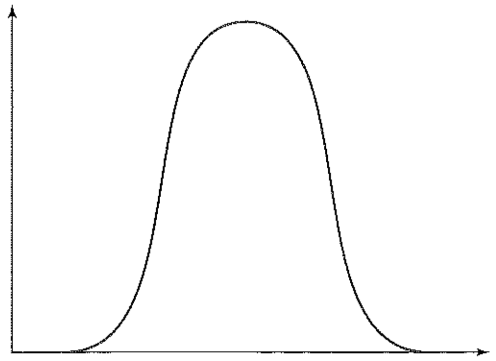

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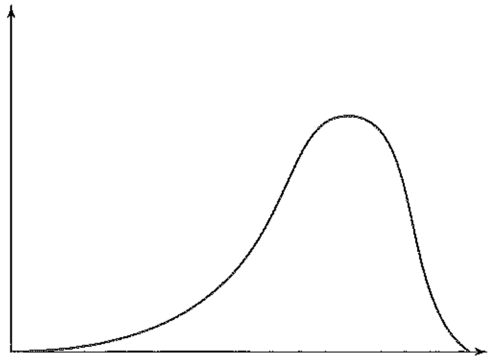
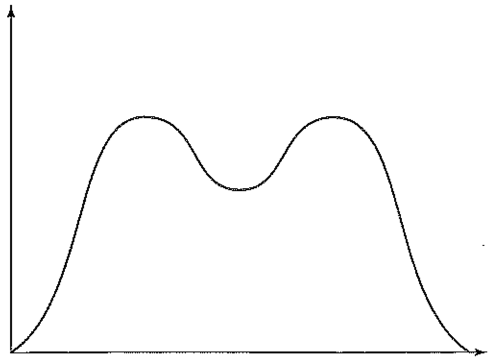
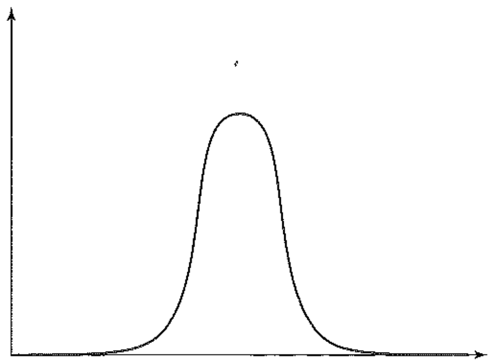


e



f





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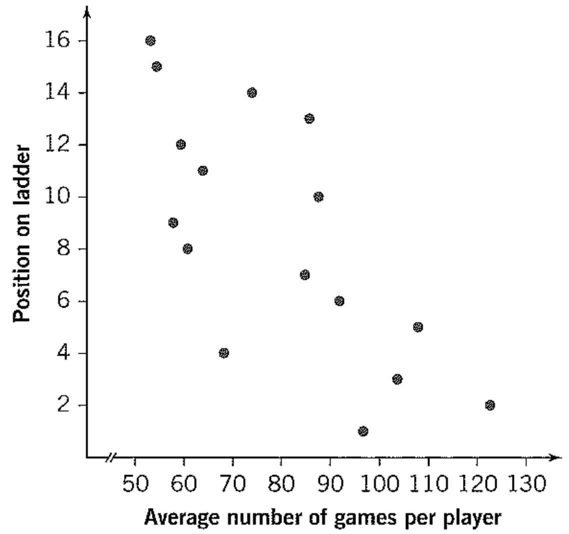
## 3.6

1 a




b This correlation is negative and is of low–moderate strength.

c The problem is that we get a 'false negative' correlation. The correlation in this case is actually positive, because more experience leads to a higher position on the ladder – but because this is a ladder situation, a higher position corresponds with a lower number, so that the correlation looks negative. If we actually think about what these data are telling us, in terms of *numbers* they show a negative correlation between actual number on the ladder and experience, but this reveals a positive correlation between team success and team experience.

## 4.1

1 a less than or equal to 5 per cent

b This means that:

- the results are statistically significant
- the independent variable has caused a change in the dependent variable
- a conclusion may be drawn

2 a greater than 5 per cent

b This means that:

- the results are not statistically significant
- the independent variable has not caused a change in the dependent variable; chance factors have caused the change
- no conclusion can be drawn

3 a less than 1 per cent

b This means that:

- the results are statistically significant
- the independent variable has caused a change in the dependent variable
- a conclusion may be drawn

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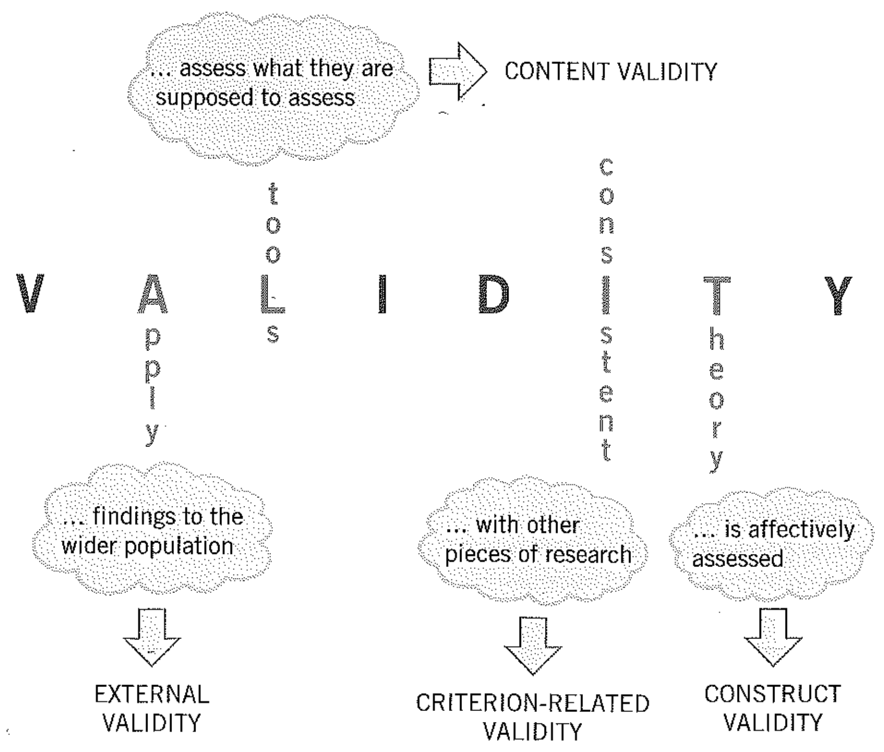
## 4.2

*There are many possible answers. Here is one suggested answer.*




## 4.3

1 **a** • Mr Heath's students are among the best and brightest in the country; therefore, they are not representative of the population.

• He has used convenience sampling by using his class; therefore, it is a biased sample.

**b** • The results were not statistically significant.

• The sample only used people over 85 years of age, so could not be applied to all age groups.

## 5.1

1 • The lecturer will be using her own students, and therefore has power over them. She has not made any effort to ensure voluntary participation.

• Pain is being administered, which causes harm to participants and may create issues with deception in research if not disclosed at the beginning.

2 *Sample answers:*

**a** Advertise for participants so that the students have to apply of their own accord and free will.

**b** After volunteers have expressed their interest, hand out a letter that explains the procedures, participants' rights and the risks involved to the participants. They must sign this before taking part in the study.

**c** Be upfront and honest about the procedure wherever possible.

**d** Allow participants to cease involvement at any time and withdraw their results at the conclusion of the research.

**e** At the conclusion of the experiment, explain all the research and findings to all of the participants and check their well-being.

**f** Ensure that all items of personal information are kept confidential.

## 5.2

1 Similarities: It is important that experimenters do no harm, or minimise harm where it is absolutely necessary.
Differences: An animal is unable to exercise its own right to withdrawn nor can it volunteer to participate, whereas a human can.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2

| Advantages | Disadvantages |
|---|---|
| Animals can help us to learn about principals regarding human behaviour without bias or expectations.<br>Animals can be more accessible than humans.<br>It is easier to obtain permission to use animals in research than it is to obtain permission to use humans.<br>Their shorter life expectancies and pregnancies help speed up research. | The results found when using animals in psychological research may not be easily generalised to the human population<br>It is difficult to determine level of harm and withdrawal rights for animals. |

## 6.1

1 **a** An investigation to test the effect of serotonin medication on depression

**b** An investigation to test the effect of preparation techniques on confidence when public speaking

2 The aim of this investigation was to test the effect of different learning techniques on confidence in public speaking. It was hypothesised that students who take acting classes will have greater confidence in public speaking, operationalised as a score on a confidence scale, than those students who learn how to write a good speech. There were 40 12-year-old students used in the investigation, of whom 24 were females and 16 were males. The results showed that students who had learnt how to write speeches ranked themselves, on average, 8.2 out of 10 on a confidence scale, whereas those who had taken acting lessons rated themselves, on average, 8.7 out of 10 on a confidence scale. In conclusion, it was found that learning acting skills is a better way to build confidence for public speaking than written preparation.

3 5 Independent and dependent variables
2 Past research
3 Aim
4 Hypothesis
1 Theories and definitions

## 6.2

- Do not personalise by using words such as 'I'.
- Attachments do not go in the reference section.
- It is not 'rare data'; it is 'raw data'.
- The 'Participants' section should appear before 'Materials'.
- The 'Participants' section should list gender of participants, gender distribution in each group and ages.
- The procedure should be dot-pointed.
- The 'Procedure' should explain what one group did in the experiment while the other group was having acting classes. We can assume from the results and the method that the non-acting-class group learnt how to write speeches, but this must be explained and outlined in the 'Procedure'.
- It is incorrect to state that a research report was written as part of the procedure.
- The report writer has presented raw data in the results; a graph or table of descriptive statistics should be shown instead of raw data.
- There is no statement of what the results show.
- The confidence ratings in the raw data given for each group are identical. It is unlikely that this would have been the case, so one of the sets of data must be incorrect.

## 6.3

1 *Sample answers:*
Extraneous variable: Differences in original confidence ratings – some participants may naturally have been more comfortable in public speaking than others.

Future improvements: Conduct a repeated-measures design so that there are no participant differences.

Extraneous variable: The topic of the speech may have been an extraneous variable; it may have been one that was more suited to acting than to a written argument.

Future improvements: Provide students with a 'neutral' topic for the speech delivery.

2 **a** Geoff, J. (2005). *Brain Surgery for Beginners*. Melbourne: Ebony House.

**b** Peters, T. (2007). *Measuring your Emotional Intelligence*. Canberra: Construction Place.

3 • The worksheet on How To Write Speeches
• A list of speech topics
• The topics covered in the acting class
• The raw data
• Any permission forms completed by participants

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